# ENHANCED THERMAL STABILITY AND FLAME-RETARDANT PROPERTIES OF CROSS-LINKED POLYMER NANOCOMPOSITES

A Dissertation

by

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# ABSTRACT

Polymeric materials have wide applications in the home and industry, providing inexpensive, lightweight, and high performance materials. However, due to the fuel-rich chemical composition of polymers, many flame-retardant additives have been developed to mitigate damages in the event of a fire. Unfortunately, some of these flame-retardants are either toxic or pose significant environmental impacts, highlighting the need for new, nontoxic and environmentally benign polymeric flame-retardants. One promising flame-retardant technology to fill this role is the polymeric nanocomposite. Firstly, the work in this dissertation aims to use thermogravimetric analysis to uncover understudied nanofillers and provide insight into new flame-retardant polymer additives. Secondly, this work aims to investigate methods to enhance the char yield and thermal stability of existing polymer nanocomposites.

Nanocomposites containing α-zirconium phosphate and poly(methyl methacrylate) were produced by solution casting. These high loading materials (0-30wt% nanofiller) retained their optical transparency, while scattering and absorbing significant amounts of UV light. The nanocomposites were largely noncombustible, with significant residuals even at very high temperatures. Lastly, α-zirconium phosphate nanocomposites had enhanced thermal stability, shown as reduced peak mass loss rates and higher activation energy for thermal decomposition. These studies provide insight into the unique properties of α-zirconium phosphate as a polymeric additive.

Aside from studying new nanofillers, the work in this dissertation aims to improve the performance of existing flame-retardant polymer nanocomposites. Poly (methyl methacrylate) nanocomposites containing montmorillonite, aluminum oxide, or silica nanofiller were cross-linked with trimethylolpropane triacrylate to study the interaction between polymer cross-linkages and nanofiller content. In all cross-linked nanocomposites observed, there were synergistic enhancements to the thermal stability of poly(methyl methacrylate), observed as an increase to the onset of degradation by nearly 100°C and an increase to the activation energy of degradation. In addition, cross-linked nanocomposites showed synergistic enhancements to char yields. Silica specially surface treated with KH570 was also used to directly cross-link poly(methyl methacrylate), but the degree of cross-linking was low and the effects were less pronounced compared to other cross-linked nanocomposites. This work shows that the combination of nanofiller additives and polymer cross-linking agents provides viable improvement to existing nanocomposites.

# DEDICATION

This dissertation is dedicated to my mother and father. Without their guidance and unconditional love, nothing I do would be possible.

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## NOMENCLATURE

| | |
|---|---|
| AO | Aluminum oxide |
| DTG | Derivative thermogravimetric analysis |
| HRR | Heat release rate |
| MMT | montmorillonite |
| pHRR | Peak heat release rate |
| PMLR | Peak mass loss rate |
| PMMA | poly (methyl methacrylate) |
| TDCPP | tris (1,3-dichloroisopropyl) phosphate |
| TGA | Thermogravimetric analysis |
| THR | Total heat released |
| TMPTA | Trimethylolpropane triacrylate |
| ZrP | $\alpha$-zircoinium phosphate |

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# 1. INTRODUCTION

## 1.1 Introduction to Flame Retardants*

Combatting the hazards associated with fires in the home and workplace is an ongoing effort requiring constant reevaluation and improvement of fire safety procedures and technologies. Damage to homes in the United States due to fires dropped from \$10.2 billion/year in 1977 to \$7 billion/year in 2011, due partially to improved fire safety standards and fire-mitigation technologies[1]. Despite the decreasing trend, the National Fire Protection Association reports that 56% of fire deaths are of individuals above the age of 50, suggesting that a disproportionate number of individuals in older demographics fall victim to house fires[2]. These data make it apparent that there is need for passive flame-retardants.

One important realm of flame-retardant research is in polymeric materials. Since the middle of the 20th century, the use of polymers in the home and industry has skyrocketed. However, in the event of a fire, the energy-dense hydrocarbon composition of polymers provides a source of fuel, making their widespread application an item of concern.

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In response, an immense amount of research has focused on reducing the flammability of polymeric materials. One early research focus was into halogenated flame-retardants, which degrade into radical scavenging products that quench free-radical reactions in the vapor phase[3]. These materials are often paired with a synergistic additive such as antimony oxide or a phosphorous-based flame-retardant to enhance char formation[4]. Some of the most common halogenated flame-retardants include tetrabromobisphenol A derivates, polybrominated diphenyl ethers, and polybrominated biphenyls, among others[5].

Another focus of research has been in phosphorous-based flame-retardants. Various phosphorous-based materials have been developed and incorporated into polymers, resulting in dramatic improvements to flammability[6]. Generally the efficacy of phosphorous-based approaches is due to the formation of char from degraded polymer and in some cases, the generation of vapor, which can dilute or quench gas-phase reactions[7]. Furthermore, vapor generation in phosphorous-based flame-retardants can help increase the volume of produced char, producing thick, expanded, intumescent barriers[6]. Examples of phosphorous-based flame-retardants include various types of ammonium polyphosphate and triphenyl phosphate, among many others[8]. Halogenated phosphorous-based materials also exist, including tris(2-chloro-ethyl) phosphate and tris(chloropropyl)phosphate, which take advantage of both halogenated and phosphorous based approaches[8].

Phosphorous-based materials are only one type of intumescent flame-retardant. Generally, intumescent systems involve the incorporation of a charring agent, a source of carbon for the charring agent, and a blowing agent to generate vapor, which increases the volume of the char to produce a thick insulating physical barrier. Some state of the art flame-retardants incorporate all three of these materials into a single intumescent additive, such as in studies with melamine salts of pentaerythritol phosphate or the familiar deoxyribonucleic acid (DNA)[6]. In addition, significant research focuses on combining intumescent flame-retardant systems with nanofillers in an effort to reinforce char and create a high quality, continuous barrier[6].

However, some of the most commonly used flame-retardants have received criticism due to their toxicity or environmentally persistent nature. Many halogenated flame-retardants have been phased-out by manufacturers, including pentabrominated diphenyl ethers (pentaBDEs), which accumulate in ecosystems where they are difficult to remove[9]. Some phosphorous-based materials have been shown to pose environmental concerns, being found in significant concentrations in the environment[8]. Furthermore, many halogenated phosphorous-based flame-retardants are potentially toxic, such as tris (1,3-dichloroisopropyl) phosphate (TDCPP) which been shown to be a neurotoxin in mice cells and a mutagen for animals[10-12].

One technology that has the potential to replace potentially toxic and environmentally persistent flame-retardants is the polymeric nanocomposite. These materials, which are traditionally composed of a polymeric matrix embedded with inorganic nanoparticles, possess high thermal stability and in some cases, the ability to produce a physical barrier at the burning surface of the material[13-17]. The barrier that forms consists mainly of accumulated, thermally-stable inorganic nanoparticles and carbonaceous char which act as shield, reducing mass and heat transport to the incident flame, while protecting unburned material behind the barrier[18, 19]. The success of some flame-retardant nanocomposites has lead to commercially available flame-retardant nanofillers, including nanoclays such as montmorillonite.

## 1.2 Mechanisms of Polymer Fires

To design effective flame-retardants, the general mechanisms of polymeric fires are first discussed. In general, the process of a polymer fire begins when a sustained source of heat causes thermal degradation of the polymer, shown in Figure 1. This region of thermal degradation is called the pyrolysis region.

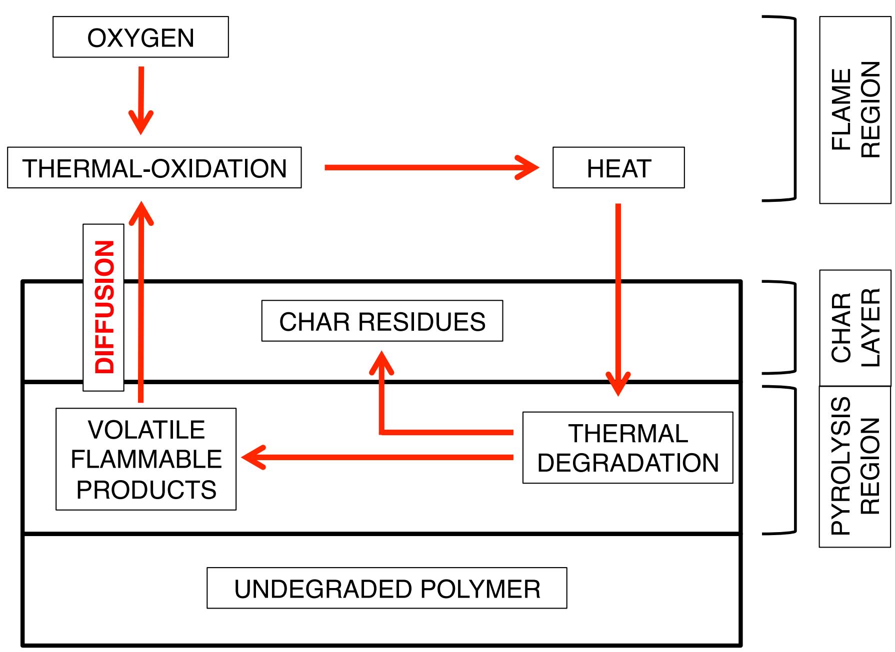


Figure 1: Schematic representation of a polymer during a fire.

The thermal degradation causes covalent bonds in the polymer backbone to break, turning long hydrocarbons into smaller, more volatile flammable organic compounds. Figure 1 also shows the degradation of polymer can lead to char formation. In reality this process is more complex, with polymer initially degrading into a tar and then further into volatiles and thermally stable char. Not all polymers inherently produce char, but additives can be introduced into the polymer to enhance char yields.

Volatile flammable byproducts of polymer degradation will defuse through the degraded polymer and char, then travel into the vapor space where they combine with atmospheric oxygen and react, forming the flame region. The heat from these thermal-oxidative reactions causes further heat generation and sustains the entire cycle.

Developing effective flame-retardants aim to break down the feedback cycle in Figure 1. By stopping this cycle, the polymer flame cannot sustain itself.

### 1.3 Polymeric Nanocomposites in Literature

Before the use of nanofillers, micro-scale additives were embedded into polymeric matrices. While improvements to thermal stability were apparent, these microcomposites required high loadings of filler to achieve significant results. Furthermore, the resulting high-loading microcomposites were significantly denser than the original polymer with dramatically altered mechanical properties[13]. By using nanofillers instead of micro-scale additives, the surface to volume ratio is dramatically increased, enhancing the interactions between the polymer and nanofiller while requiring a much smaller loading of filler[13].

In the last three decades, significant work has been conducted in the field of thermally stable and flame-retardant polymeric nanocomposites. Many different nanofillers with different geometries have been studied[20, 21]. Some of these nanofillers are nanoscale in only one dimension, known as a nanolayer or a nanoplate. Other nanofillers are nanoscale in two dimensions, known as a nanofiber if solid, or a nanotube if hollow. Lastly, if a nanofiller is nano-scale in all three spatial dimensions, it is a nanoparticle or a nanosphere[20, 21].

The dispersion of nanofiller in polymer will drastically affect the surface area of the nanofiller exposed to polymer, and thus the amount of interaction the nanofiller has with the polymer. Nanocomposite dispersion can be conceptually classified into one of three different categories, as shown in Figure 2. If a nanofiller is poorly dispersed, the nanofiller will agglomerate together into large micro-scale material, forming a microcomposite. Since the nanofiller agglomerates are large, phase separation can be an issue in these cases. If the nanofiller is partially separated by polymer chains, but still ordered with a characteristic length between individual nanofiller particles, the dispersion is said to be intercalated. Lastly, if the nanofiller is entirely dispersed, with each nanofiller surrounded entirely by polymer, the dispersion is exfoliated[13].

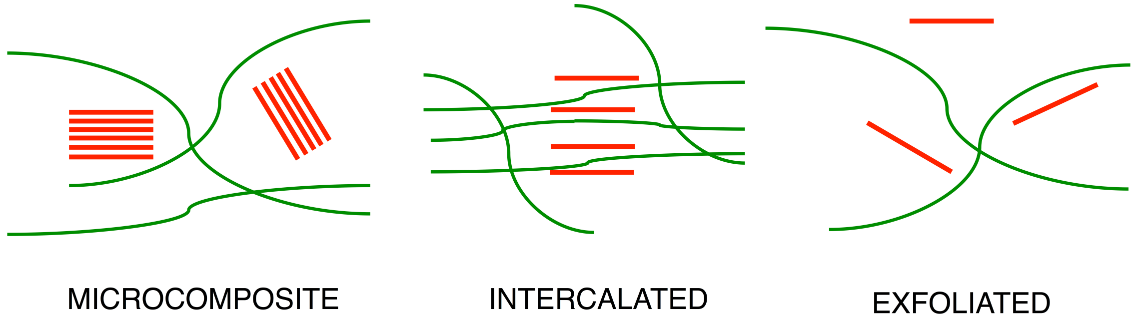


Figure 2: Diagram of nanoparticle dispersion. Agglomerated microcomposite (left), intercalated nanocomposite (center), and an exfoliated nanocomposite (right). Nanofiller is shown in red, while polymer chains are shown in green.

Nanocomposites in literature have incorporated many types of different nanofillers. Since many clays have nanoscale features, their implementation into nanocomposites has been widespread. An example is montmorillonite, a material composed of stacks of negatively charged nanolayers separated by a balance of positive cations. However, in montmorillonite, the small cations only allow an interlayer distance of approximately 1nm, hindering the movement of polymer into these galleries, making complete dispersion difficult. The modification of clays to incorporate organic surface treatments has thus been used extensively to make the dispersion of nanoclays into polymeric materials possible. Other natural clays such a hectorite and saponite have been used, as well as synthetic clays such as layered double hydroxides[13, 22]. Synthetic clay nanofillers allow a high degree of control over the final morphology of the additive, making them attractive for research applications.

Aside from clays, many other nanofillers have been studied in literature. Fumed silica is commonly studied, as well as metal oxides, such as titanium dioxide ($TiO_2$), iron oxide ($Fe_2O_3$), and aluminum oxide ($Al_2O_3$)[13]. One of the most effective and widely used nanofillers studied is the carbon nanotube. Different types of carbon nanotubes with various different morphologies have been studied with dramatic enhancements.

Generally, the enhancement to the thermal degradation and flame-retardancy of polymeric nanocomposites is due to several parameters. The type of nanofiller, including the geometry and chemical structure, and amount of nanofiller are two major factors since they play a role in the nanofiller dispersion, and dictate the reactivity of the nanofiller with the polymer[13]. In some cases, the surface of the nanofiller promotes the formation of char[23, 24]. The presence of char indicates incomplete combustion, with carbon sequestered in the condensed phase, instead of being transported to the vapor phase where the thermal-oxidative flame region exists. Increasing char yield also enhances the barrier that forms at the surface of a burning nanocomposite, providing additional protection against the incident heat from the flame. The permeability of nanofiller is also important for thermal degradation reactions. Impermeable nanofillers act as a barrier for reactants while simultaneously preventing volatile, flammable degradation products from exiting the material[13].

**1.4 Existing Nanocomposite Synthesis Techniques**

Since their inception, flame-retardant polymeric nanocomposites have been synthesized using many diverse methods. It is necessary to review commonly used synthesis approaches to better understand inherent differences in experimental setups and to review the benefits and drawbacks of each method. Four major techniques are discussed here as follows: 1) extrusion, 2) solution casting, 3) *in-situ* polymerization, and 4) layer-by-layer deposition.

### *1.4.1 Extrusion Methods*

Polymer extrusion is the process of melting a polymer and then passing it through a die to produce a polymeric material of constant cross-section, shown schematically for a twin-screw extruder in Figure 3. Polymer beads and nanofiller are fed by the hopper into the extruder. Heating elements provide heat to melt the polymer, while rotating screws mix and transport the polymer melt through the extruder. The final mixed polymer melt is pushed through the die, producing a constant cross-section nanocomposite.

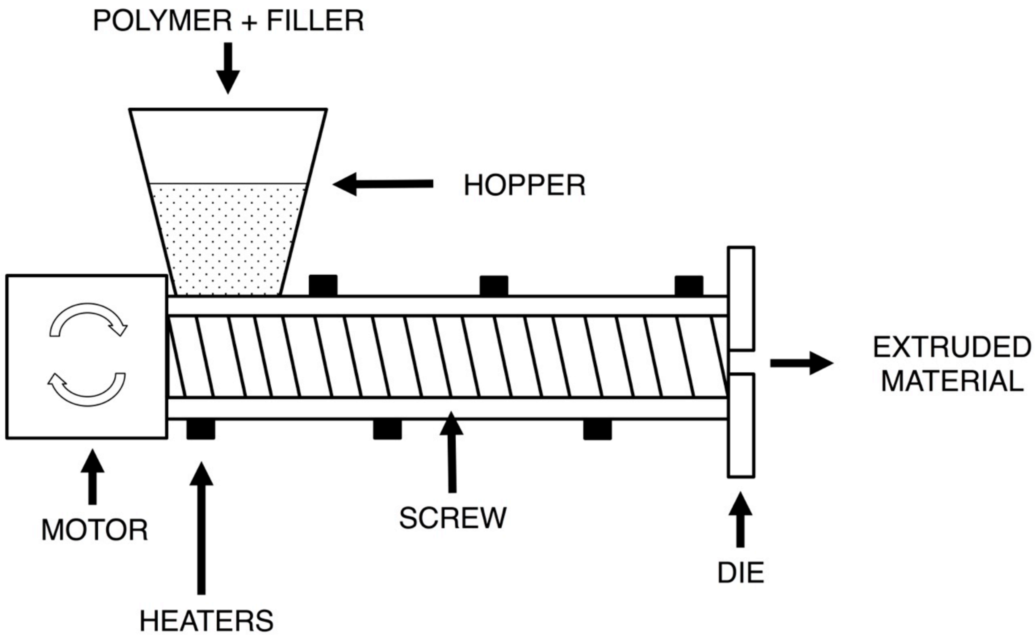


Figure 3: Diagram of a screw extruder.

Extruders are used to mix polymer melts with inorganic nanofiller, providing a simple one-step method to produce nanocomposites without the use of solvents or drying steps. In addition, extrusion can use pre-synthesized polymer beads to produce nanocomposites, decoupling the polymerization process from the nanoparticle embedding process and allowing fine tuned control over polymer samples. However, extruders cannot create coatings, and large materials become cumbersome since they require an impractically large die, making polymer extruders unfeasible for some applications.

### *1.4.2 Solution Casting Methods*

Another method to produce nanocomposites is through solution casting, which is common in nanocomposite preparation. A polymer solution is first prepared by dissolving polymer beads into a suitable solvent under mechanical mixing, shown in Figure 4. Nanofiller is mixed into to the solution to produce a polymer/solvent solution dispersed with nanofiller. A sample of the solution is placed on a heated substrate to remove solvent, shown in the diagram in Figure 5. Vacuum solvent removal may be required during drying to remove all solvent content.

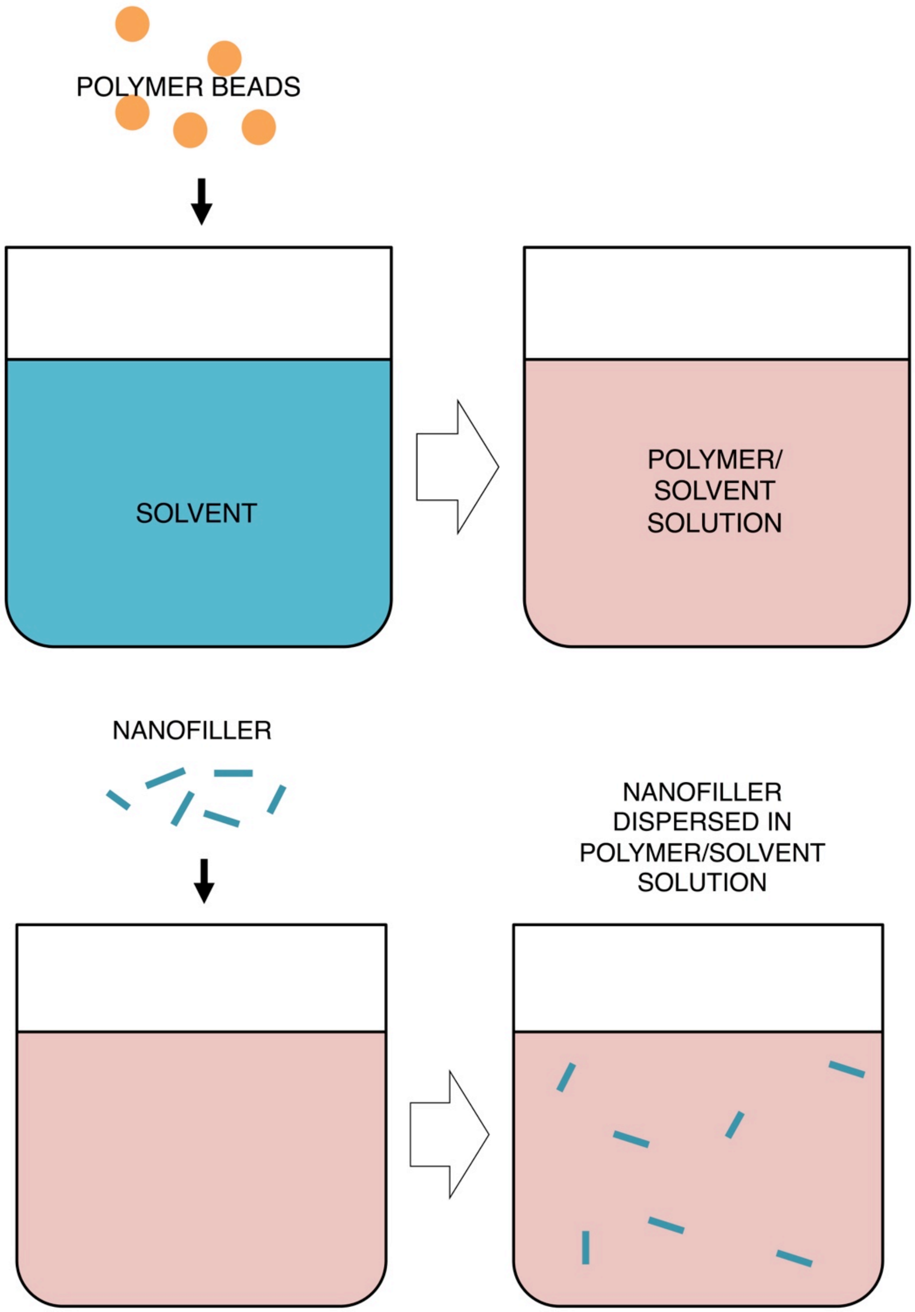


Figure 4: Preparation of a nanofiller dispersion in a polymer/solvent solution. Polymer beads are dissolve in solvent (top), followed by addition of nanofiller to produce a dispersion (bottom).

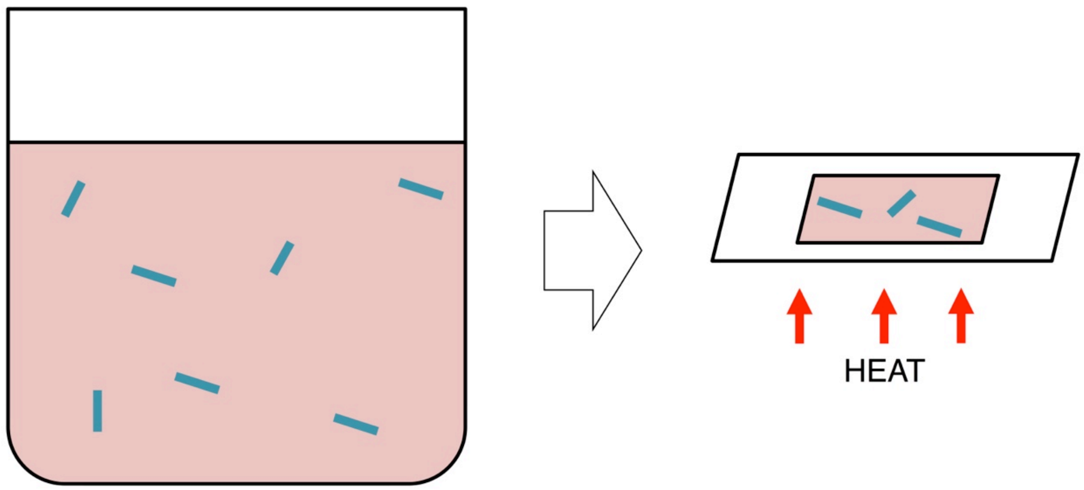


Figure 5: Sample drying. Dispersion is dried on a heated substrate to produce free-standing nanocomposite films.

Solution casting is an attractive method due to the simplicity of synthesis. Similar to extrusion, solution casting decouples the polymer synthesis step and the nanoparticle embedding step, allowing for a high degree of control over the final material. In addition, the use of a solvent aids in the dispersal of nanoparticles in the polymer phase, allowing for a high degree of particle dispersion. Lastly, solution casting only requires conventional laboratory equipment, making the financial barrier of solution casting low.

However, solution casting has significant short-comings. The introduction and subsequent removal of solvent makes drying nanocomposites produced by solution casting challenging. Either elevated temperatures, a vacuum, or both are required to reduce solvent concentrations in nanocomposite to manageable levels. For this reason, thick nanocomposites are difficult to produce using solution casting. Solvent becomes increasingly more difficult to remove from the interior of thick samples, making coatings the most practical application for solution casting.

### *1.4.3* **In-Situ** ***Polymerization***

*In-situ* polymerization is another technique for producing polymer nanocomposites. This method involves dispersing nanoparticles into a monomer through mechanical mixing, then polymerizing the monomer to lock the nanoparticles in place, shown in Figure 6 and Figure 7.

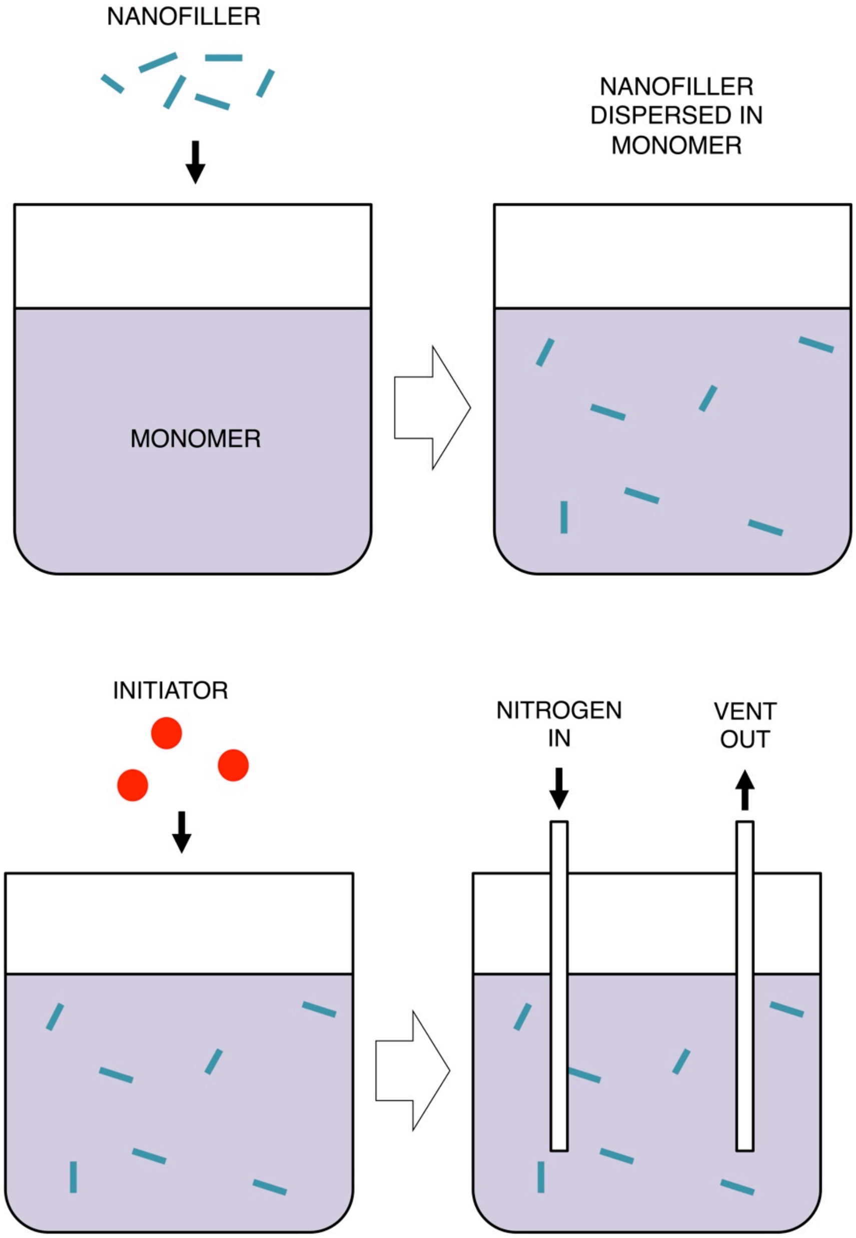


Figure 6: Disperse and inerting procedure. Preparation of nanofiller dispersed in monomer (top), followed by addition of initiator and oxygen removal (bottom).

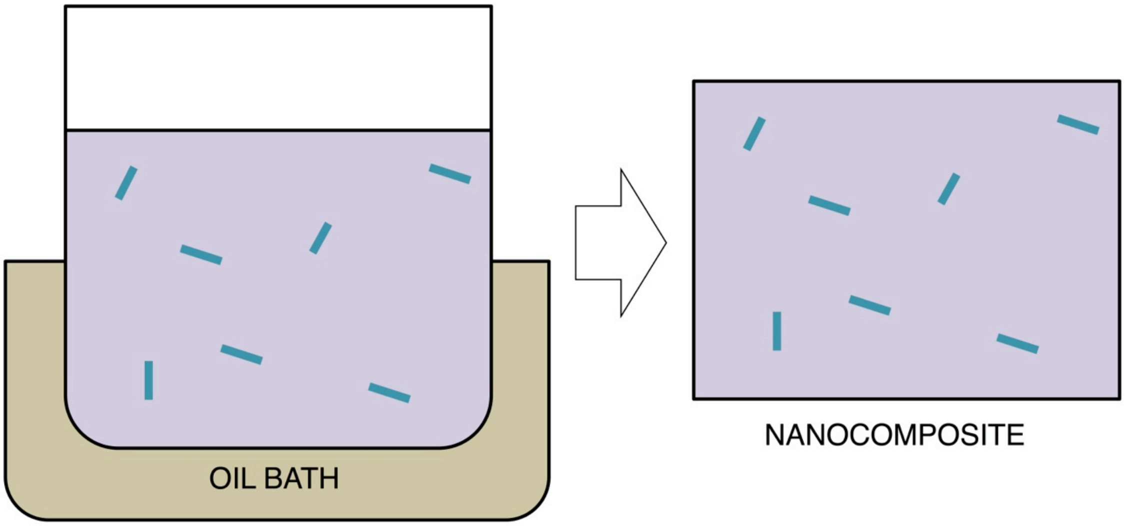


Figure 7: Nanofiller dispersion is polymerized in an oil bath. After curing, the nanofiller is locked into place by the polymer.

This method has significant benefits over other methods. Firstly, additional solvents are not required to disperse nanoparticles since the monomer fills this position. Therefore, solvent removal is much less of an issue since the monomer concentration after polymerization can be relatively low. Since solvent removal is not an issue, thicker samples can be made, similar to solution casting. However, it is equally simple to make coatings, giving *in-situ* polymerization a benefit over both extrusion and solution casting. Lastly, *in-situ* polymerization only requires commonly used laboratory equipment such as hot plates, making the financial barrier for nanocomposite synthesis low, comparable to solution casting methods.

### *1.4.4 Layer-by-Layer Deposition*

The last nanocomposite synthesis method discussed here is layer-by-layer deposition. This technique involves the deposition of materials on a substrate. Generally, this technique utilizes two solutions, one containing a nanoparticle with a partial charge, and those others containing a polymeric ionomer with the opposite charge, outlined in Figure 8. The substrate is dipped into one solution, gently washed and dried, and then dipped in the second solution in an alternating fashion, as shown in Figure 9. Each submersion adds a thin layer of material deposited on the substrate, and over repeated alternating submersions, a thin layer builds up, shown in Figure 10.

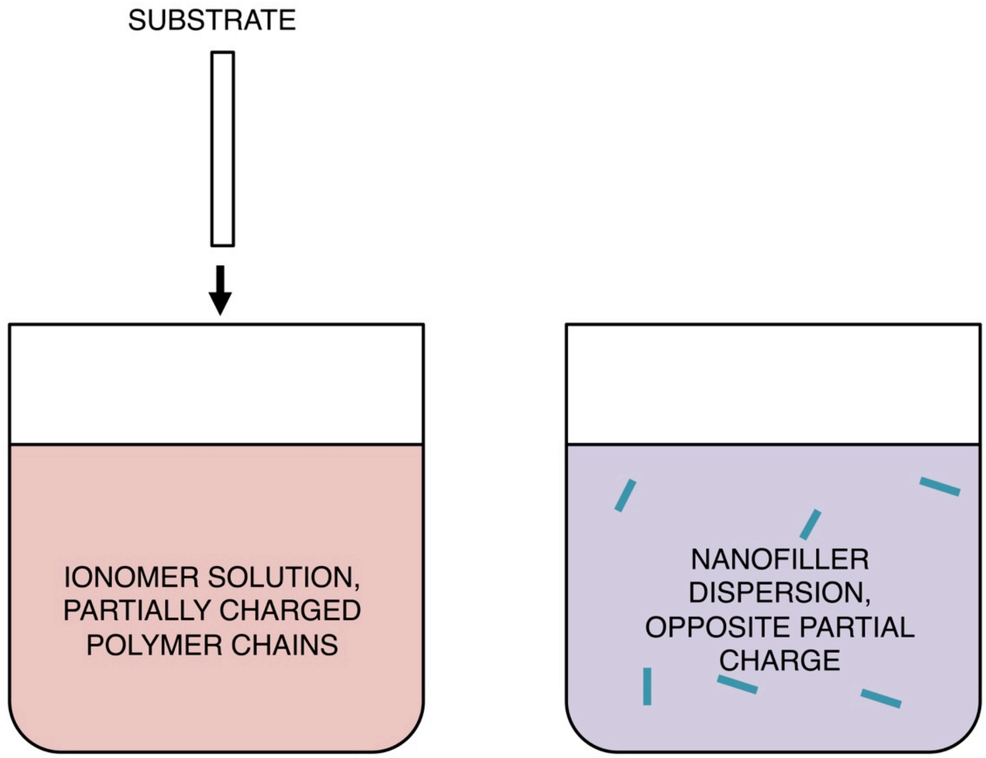


Figure 8: Two solutions are utilized in layer-by-layer. Process starts by dipping substrate into one solution.

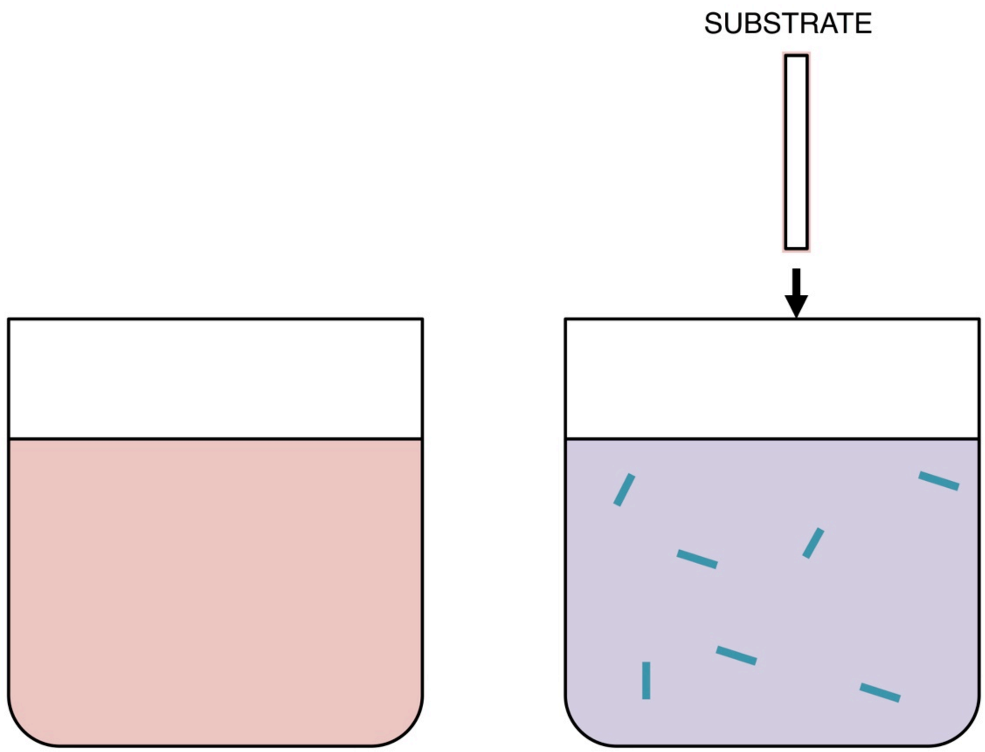


Figure 9: Substrate is gently washed and dipped into the second solution.

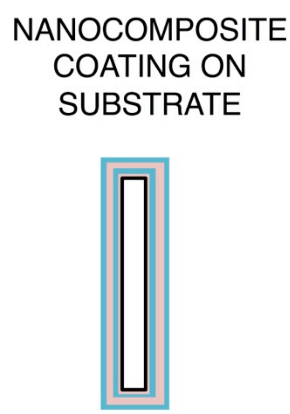


Figure 10: Repeat submersion. After several successive alternating coatings are made, a thin layer is formed consisting of individual layers.

Layer-by-layer nanocomposites have been shown to be highly effective as flame-retardants and gas-barriers, but they are not perfect. Firstly, the procedure for production is difficult to scale due to the degree of processing required. In addition, layer-by-layer nanocomposites can only make coatings and are not effective in producing bulk materials. For simple lab-scale tests, layer-by-layer deposition is cheap, but to scale up and adopt into real-world applications, there are significant challenges.

## 1.5 Relevant Polymer Degradation Kinetics

Observing the degradation kinetics of polymers is important for understanding changes in the underlying decomposition reactions that make polymeric nanocomposites so effective. In general, the thermal degradation of polymers occurs in several distinct pseudo-step reactions. Each pseudo-step reaction is in fact a grouping of many degradation reactions. In terms of Figure 1, common polymer degradation kinetics group all condensed phase phenomena into a single pseudo step reaction. Using this methodology, polymer degradations can be summarized as a few pseudo-step reactions, instead of hundreds or thousands of actual chemical reactions.

To understand the degradation of PMMA, synthesis must first be discussed. To begin the synthesis of PMMA, the initiator is decomposed to produce free-radicals. A portion of these free-radicals are transferred to the monomer, methyl methacrylate (MMA). This free-radical monomer reacts with other monomers, growing in length to become a polymer chain, while maintaining a reactive free-radical end. Due to steric hindrances, free-radical chain growth generally favors head-to-tail reactions, rather than head-to-head reactions.

After a conventional free-radical polymer chain has formed, it is eventually terminated in one of two ways. The first type of termination is called disproportionation. This occurs when the free-radicals from two growing chains react to form two independent, terminated polymer chains. If the two growing chains are of length A and B, the result of disproportionation will be two polymer chains of length A and B, with one of the two having an unsaturated end, and the other have a saturated end. The second type of termination is called recombination. Recombination occurs when two growing free-radical polymer chains combine to form a single chain. If the growing chains are of length A and B before recombination, their final length will be A+B, with the original free-radical chains forming a single covalent bond. Since free-radical polymerization generally occurs from head to tail, recombination forces a sterically hindered head-to-head bond to form.

When PMMA thermally degrades, as studied by Kashiwagi, the weakest bonds will break first at lower temperatures[25]. Generally, the head-to-head bonds formed by recombination are the weakest due to the high level of steric hindrance. The next weakest bonds are the unsaturated ends formed during disproportionation. Third, the covalent bonds between the carbon-carbon linkages in the polymer backbone break. The individual monomers only thermally degrade at high temperatures in the vapor phase, potentially burning if oxygen and an ignition source are present. Furthermore, since oxygen readily stabilizes free-radicals, the presence of oxygen actually stabilizes these condensed phase free-radical reactions.

### *1.5.1 Quantifying Degradation Kinetics*

Since most polymer thermal degradation reactions are solid to gas phase reactions, they can easily be quantified using thermogravimetric analysis (TGA) techniques. Besides directly observing onset degradation temperature, char residuals, and thermal stability, TGA can be used to determine important kinetic information, such as the form of the kinetic rate equation and the activation energy for reactions. The form of the kinetic equation can give insight in the mechanism of degradation, while enhancement to the activation energy are traditionally interpreted as either a stabilization of the reaction or a change in the mechanisms of degradation. Using TGA to compare polymeric materials with different nanocomposites gives insight to why nanocomposites are effective as flame retardants.

In general, TGA data can be either isothermal or a dynamic temperature ramp over time. In isothermal operation, a constant temperature is held and the mass of a sample is measured over time. A major limitation to isothermal TGA is a temperature must be chosen for the test, when in reality degradation reactions can change greatly depending on the temperature. This equates to either many isothermal tests, or limited data. Dynamic temperature TGA is usually done by weighing the sample as it is heated at a constant temperature ramp rate, such as 10°C/min. This captures a wide spectrum of temperatures, making changes in degradation mechanism with temperature observable with only one test. Furthermore, dynamic tests make it possible to easily measure kinetic parameters, such as the activation energy and high temperature residuals. In addition, many detailed kinetic models are available for dynamic TGA, making it an invaluable tool for the analysis of polymer degradation kinetics.

### *1.5.2 Differential Models*

A general solid-state reaction can be described by a simple kinetics equation, shown in Equation 1.

$$\frac{d\alpha}{dt} = Ae^{\left(-\frac{E_a}{RT}\right)} f(\alpha) \tag{1}$$

where $\alpha$ is the degree of degradation (similar to conversion, 0 mean no degradation has occurred, 1 means the solid is entirely decomposed), A is the Arrhenius Rate Law pre-exponential, $E_a$ is the activation energy for the degradation reaction, R is the Universal Gas Constant, T is temperature in Kelvin, and $f(\alpha)$ is the reaction mechanism model.

It should be noted in Equation 1, it is assumed there are no significant temperature gradients in the sample, which is reasonable since TGA samples small (~5mg). In dynamic TGA tests, there are two major groups of kinetic models for solid-state reactions. The first of these models is the differential model, which as the name implies, requires the evaluation of a derivative. To better understand how differential models can be used, the general kinetics equation shown previously in Equation 1 is rearranged and shown as Equation 2 below, similar to the pioneering works of Freeman.

$$ln\left[\frac{\left(\frac{d\alpha}{dt}\right)}{f(\alpha)}\right] = ln(A) - \frac{E_a}{RT} \tag{2}$$

Equation 2 is linear, with the derivative of α with respect to time and the kinetic model, f(α), appearing in the y axis, with a slope of $-E_a/R$, and a y-intercept equal to ln(A).

In practice, $ln\left[\frac{\left(\frac{d\alpha}{dt}\right)}{f(\alpha)}\right]$ is plotted against $\frac{1}{T}$. If a reasonable form of f(α) is used, the plot will be linear. This also functions as a method to validate a hypothesized kinetic form. A form of f(α) is chosen, and if the plot can be linearized, the kinetic model is reasonable. In addition, the activation energy and Arrhenius Pre-Exponential can then be found from the slope and y-intercept, respectively.

The model for f(α) can take many forms. For conventional nth-order degradations, f(α) is shown in Equation 3.

$$f(\alpha) = (1 - \alpha)^n \tag{3}$$

where n is the order of the reaction.

More complex forms of f(α) include 1D, 2D, and 3D steady-state diffusion, shown in Equation 4, Equation 5, and Equation 6, respectively.

$$f(\alpha) = \frac{1}{2\alpha} \tag{4}$$

$$f(\alpha) = -\frac{1}{ln(1-\alpha)} \tag{5}$$

$$f(\alpha) = \frac{3}{\left[2\left((1-\alpha)^{-\frac{1}{3}} - 1\right)\right]} \tag{6}$$

Also common in polymer kinetics, contracting area and volume kinetics can also be included in f(α) as shown in Equation 7 and Equation 8, respectively.

$$f(\alpha) = 2(1-\alpha)^{\frac{1}{2}} \tag{7}$$

$$f(\alpha) = 3(1-\alpha)^{\frac{2}{3}} \tag{8}$$

### *1.5.3 Integral Models*

A second family of kinetic models exist called integral models. In this case, the differential form of Equation 1 is integrated, removing the differential term seen in differential models. The most common integral model is that developed by Flynn, Wall, and independently, Ozawa. First equation 1 is integrated in terms of temperature and degree of degradation, shown in Equation 9.

$$\int_{\alpha_0}^{\alpha} \frac{d\alpha}{f(\alpha)} = \int_{T_0}^{T} \frac{A}{\beta} e^{\left(-\frac{E_a}{RT}\right)} dT \tag{9}$$

where the subscript 0 denotes initial conditions before degradation, and $\beta$ is the heat ramp rate. By definition of $\alpha_0$ and $T_0$, Equation 9 can be rewritten as shown in Equation 10, and then transformed using an approximation by Doyle, as shown in Equation 11.

$$\int_{0}^{\alpha} \frac{d\alpha}{f(\alpha)} = \int_{0}^{T} \frac{A}{\beta} e^{\left(-\frac{E_a}{RT}\right)} dT \tag{10}$$

$$\int_{0}^{T} e^{\left(-\frac{E_a}{RT}\right)} dT = \frac{E_a}{R} p \frac{E_a}{RT} \tag{11}$$

where p is a parameter tabulated by Doyle for this approximation. Furthermore, if $\frac{E_a}{RT}$ is larger than 20, the approximation in Equation 12 is valid.

$$log\left[p\left(\frac{E_a}{RT}\right)\right] = -2.315 - 0.4567\frac{E_a}{RT} \tag{12}$$

The left side of Equation 10 is only dependent on $\alpha$, and for any $\beta$, will remain the same. Therefore, for the isoconversional case, we can incorporate Equation 10, Equation 11, Equation 12 and linearize the equation to arrive at the final equation, shown in Equation 13.

$$\ln(\beta) = ln\left(\frac{AE_a}{Rg(\alpha)}\right) = 5.523 - 1.052\left(\frac{E_a}{RT}\right) \tag{13}$$

where $g(\alpha)$ is the integral form of the kinetic form, commonly represented as $g(\alpha)$ = kt. The integral form is explicitly related to $f(\alpha)$ through Equation 14.

$$g(\alpha) = \int_{\alpha_0}^{\alpha} \frac{d\alpha}{f(\alpha)} \tag{14}$$

The Flynn-Wall-Ozawa method is an isoconversional method, meaning data points are linearized for a constant value of $\alpha$. For example, two TGA tests were done using $\beta = \beta_1$ and $\beta = \beta_2$. First, a value of $\alpha$ is chosen, $\alpha = \alpha_1$. For a ramp rate of $\beta_1$, the temperature at which $\alpha_1$ occurs is noted and recorded as $T_1$. This is repeated for a ramp rate of $\beta_2$, recording the second temperature, $T_2$. This data can then be linearized according to Equation 13, with a slope equal to $-1.052\frac{E_a}{R}$. This process is repeated again and again for a value of $\alpha + \Delta\alpha$ until the desired range of $\alpha$ has been covered. The resolution of the analysis, $\Delta\alpha$, can be chosen to given finer or courser data resolution.

### *1.5.4 Model-Free Methods*

The kinetic method developed by Flynn, Wall, and Ozawa does not require prior knowledge of the kinetic form, $f(\alpha)$, or the integral form of $f(\alpha)$, $g(\alpha)$, making it a model-free analysis. Similar to the analysis by Flynn, Wall, and Ozawa, other model-free methods exist. One of the most commonly used techniques was developed by Friedman. Again, if we consider a basic solid-state reaction, defined by the mass balance in Equation 1, we can rewrite and linearize the equation into a new form, shown in Equation 15[26].

$$ln\left(\frac{d\alpha}{dt}\right) = ln[Af(\alpha)] - \frac{E_a}{RT} \tag{15}$$

The plot of linearized data with $\frac{1}{T}$ as the x-axis and $ln\left(\frac{d\alpha}{dt}\right)$ as the y-axis will give a line with the slope equation to $-E_a/R$. If a form of $f(\alpha)$ is known, the Arrhenius Pre-Exponential, A, can also be found and vise-versa. Since this method does not require the approximation of an integral, it is generally considered more accurate when compared to integral models.

Another model-free method was developed by Kissinger, Akahira, and Sunose, and later modified by Starink to provide more accurate results. Kissinger, Akahira, and Sunose derived this method, similar to the Flynn-Wall-Ozawa method, starting with Equation 9, then approximating the integral. The integral approximation used by

Kissinger- Akahira, and Sunose provides more accurate results than the Doyle approximation used in the Flynn-Wall-Ozawa method. The resulting linear equation is shown in Equation 16[27].

$$ln\left(\frac{\beta}{T^2}\right) = c - \frac{E_a}{RT} \tag{16}$$

where c is a constant.

Starink later fit the resulting equation to empirical data, providing more accurate agreement, shown in Equation 17[28].

$$ln\left(\frac{\beta}{T^{1.92}}\right) = c - 1.0008\,\frac{E_a}{RT} \tag{17}$$

# 2. PROBLEM STATEMENT AND OBJECTIVES

Generally, flame-retardant polymer nanocomposites are composed of a polymeric matrix embedded with nanoparticle filler. Previously, these materials have shown superior thermal stability and enhanced char yields. In the event of a fire, enhanced thermal stability increases the resistance the polymer has to heat damage. Furthermore, increased char yields indicate more carbon is retained in the condensed phase during a fire, reducing the amount of volatile degradation products that reach the vapor phase and burn.

The objective of this study is to improve the thermal stability and char yields of flame-retardant polymer nanocomposites. This is accomplished in two ways. Firstly, understudied nanofiller additives were used to produce ZrP/PMMA nanocomposites and the char yield, thermal stability, and optical properties were reported. Secondly, this work improves existing flame-retardant nanocomposites by identifying synergism between nanofillers and secondary additives and quantifies the effects on thermal stability and char yield. Specifically, the objectives in the study include:

1) Initial study of ZrP nanocomposites. The thermal stability, kinetics of thermal degradation, and optic properties of ZrP/PMMA are investigated, giving insight into this understudied nanofiller. The development of casting and synthesis procedures is necessary for this objective, providing initial methodology to how nanocomposites are produced in this work.

2) Identification of a potentially synergistic flame-retardant system. An extensive literature review are conducted to identify potential additives that can be used in conjunction with nanofiller in polymeric nanocomposites, producing synergistic flame-retardant effects.
3) Quantification of synergistic interactions between nanofiller and synergistic additive. A factorial design of experiments is developed to test how the loading of nanoparticles and the loading of synergistic additives affect the thermal stability and char yield of a nanocomposite.
4) Synthesis and characterization of synergistic nanocomposites. Nanocomposites are characterized to understand synergistic enhancements to the char yield and thermal stability, giving additional insight into how other nanocomposites can be improved.

# 3. DEVELOPMENT OF NANOCOMPOSITE CASTING TECHNIQUES

## 3.1 Development of Solution Casting Techniques

Solution casting was initially used for preliminary results due to simplicity. The methodology involves dissolving existing polymer beads in solvent to produce a polymer solution. Additives can be mixed into this solution, producing a suspension, which can then be cast onto a surface and dried, producing a free-standing polymer film.

In this work, PMMA beads were dissolved into DMF to produce a 20wt% PMMA in DMF solution. The nanofiller, ZrP, was added to the solution and mixed for several hours, then cast onto a heated glass plate to encourage solvent removal. The resulting free-standing nanocomposite films were well mixed and transparent even up to 30wt% nanofiller.

## 3.2 Development of Small-Scale *In-Situ* Polymerization Methods

Although solution-casting methods are simple, the removal of solvent becomes difficult with thicker samples. To improve the casting method, an *in-situ* method was developed. First, nanofiller (or other additives) were added to the monomer, MMA, in a sealed glass vial and mixed for 30 minutes and then ultrasonicated for an additional 30 minutes. The initiator, ABCN, was added and nitrogen was bubbled through the solution to removed oxygen content, as shown in Figure 11. The solution was polymerized at

70°C in an oil bath, as shown in Figure 12. Five minutes before the polymer solution gelled, it was transferred to small polypropylene vials fitted with buoyant foam and allowed to float in the oil bath for an additional 24 hours, as shown in Figure 13. Photographs of various samples produced using this method are shown in Figure 14.

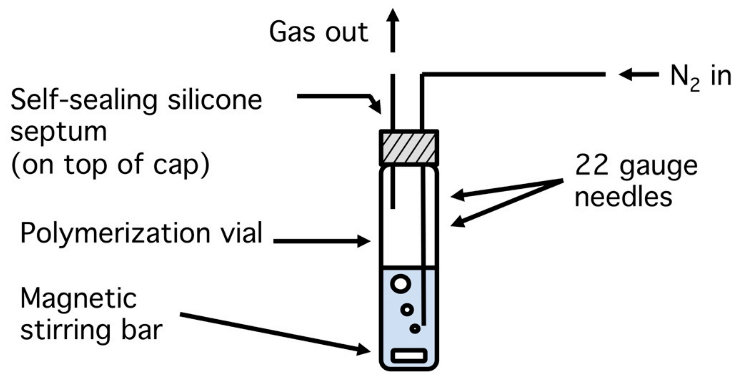


Figure 11: Setup for maintaining an inert atmosphere during polymerization.

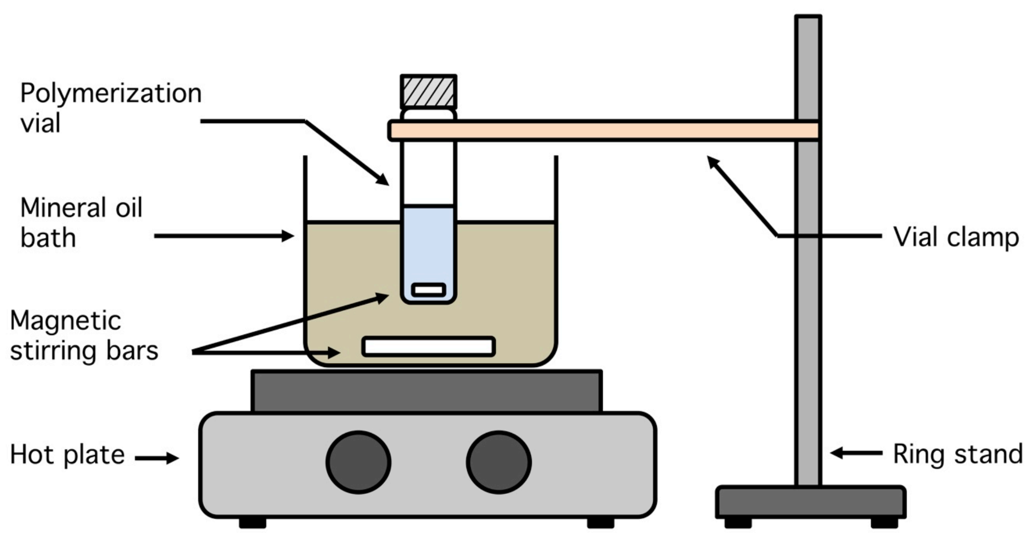


Figure 12: Polymerization setup.

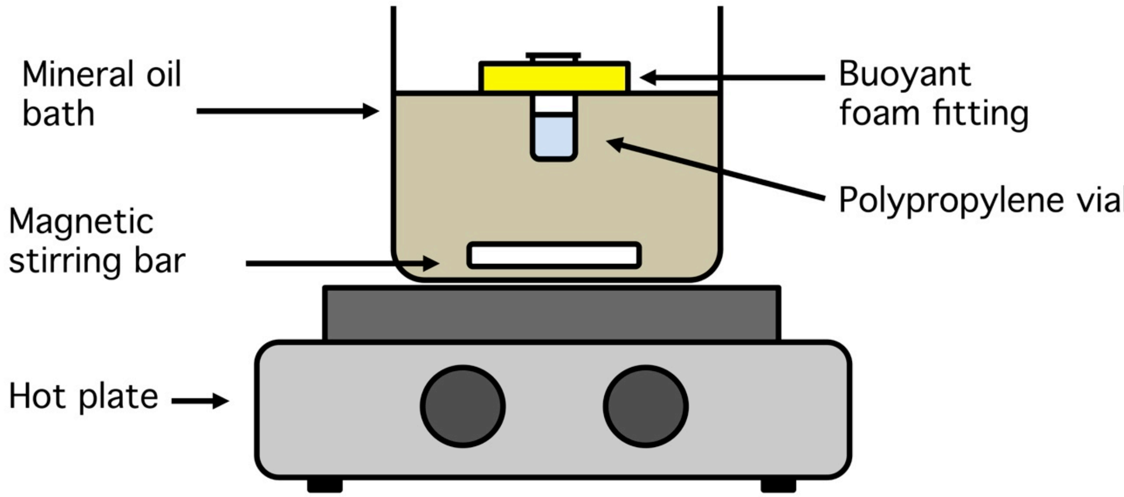


Figure 13: Casting setup for small samples.

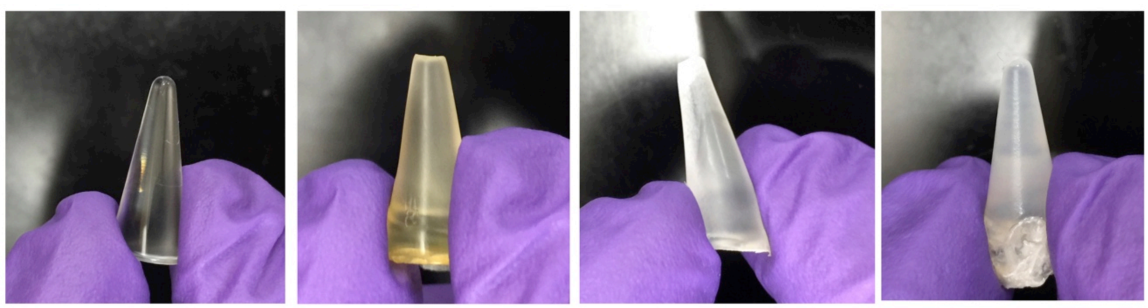

Figure 14: Small samples synthesized through *in-situ* method. From left to right: neat PMMA, 1wt% MMT in PMMA, 1wt% silica in PMMA, and 1wt% AO in PMMA.

### 3.3 Development of Medium-Scale *In-Situ* Polymerization Methods

Similar to the small-scale *in-situ* samples, a method to produce medium-scale samples for fire-testing was also developed. The medium-scale samples are prepared identically to small samples, except a specialized mold is used for casting. Often to produce medium to large-scale *in-situ* samples, large explosion-proof polymerization ovens are necessary, presenting a barrier to synthesis. Therefore, a method to produce medium-scale samples using an oil bath was developed. First, a length of silicone tubing is placed on a glass pane to form a “U” shape, as shown in Figure 15. The “U” shape eventually forms the cavity for the mold. The choice of tubing materials is important, as harder plastics such as polyethylene or polypropylene tubing will not provide an adequate seal against the oil bath.

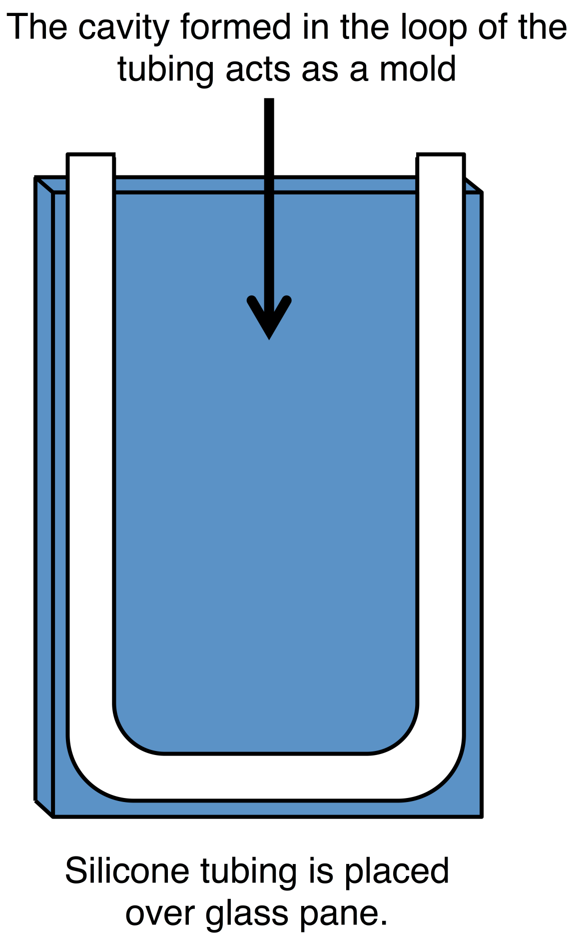


Figure 15: A length of silicone tubing is placed over a glass pane. The tubing forms a "U" shape.

A second pane of glass is placed on top of the tubing, shown in Figure 16. By holding the panes of glass together, the tubing is sandwiched into place and holds the "U" shape.

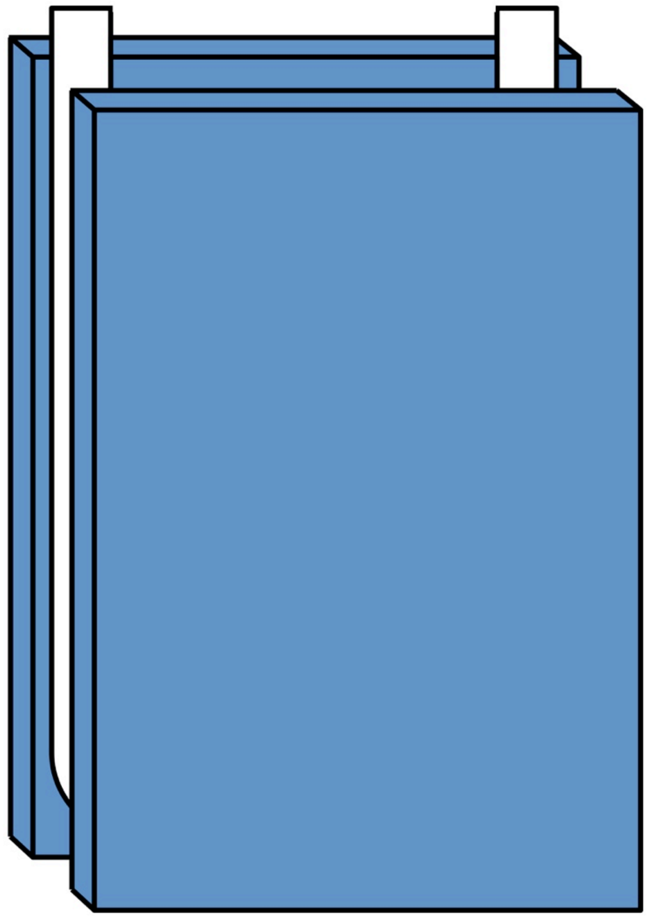


Figure 16: Silicone tubing sandwiched between two panes of glass. This forms a cavity between the plates.

Large metal clips are used to hold the two panels of glass together with the tubing sandwiched between, shown in Figure 17 and Figure 18. An opening is left at the top of the mold to allow it to be filled with polymerizing solution. Similar to small samples, at 5 minutes before the solution gels, the solution is cast into the mold.

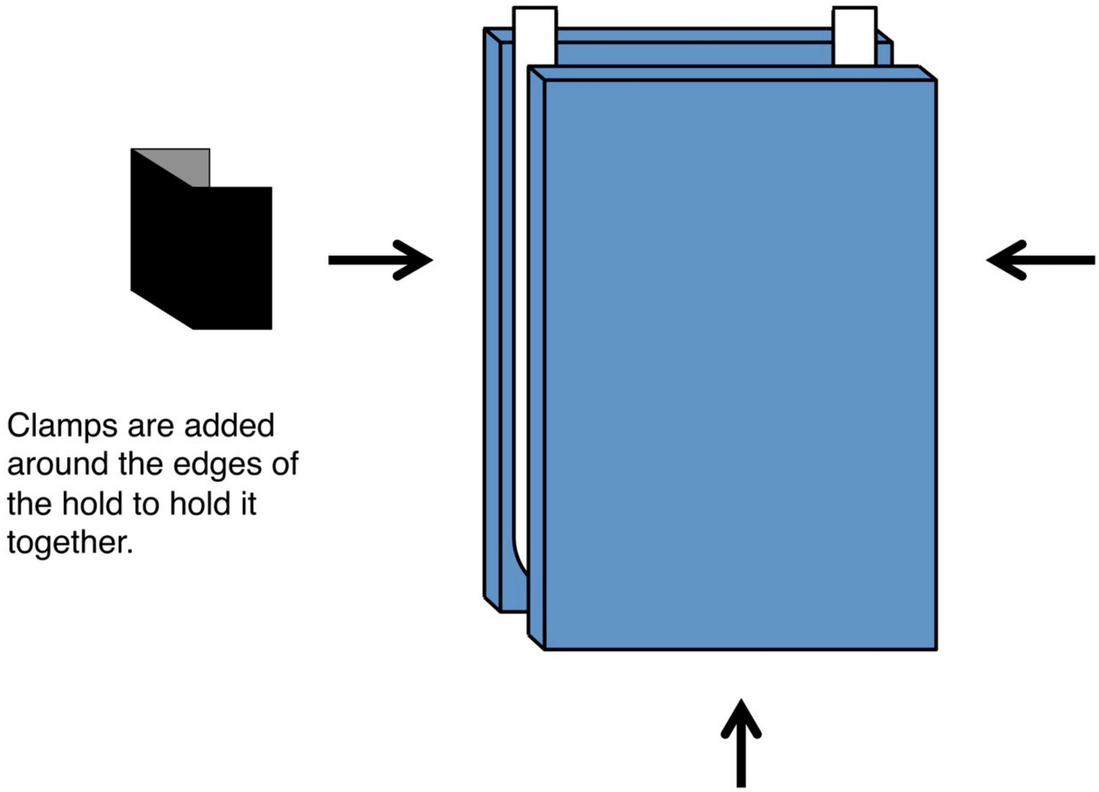


Figure 17: Metal clamps are secured onto the edges of the mold. This holds the mold together.

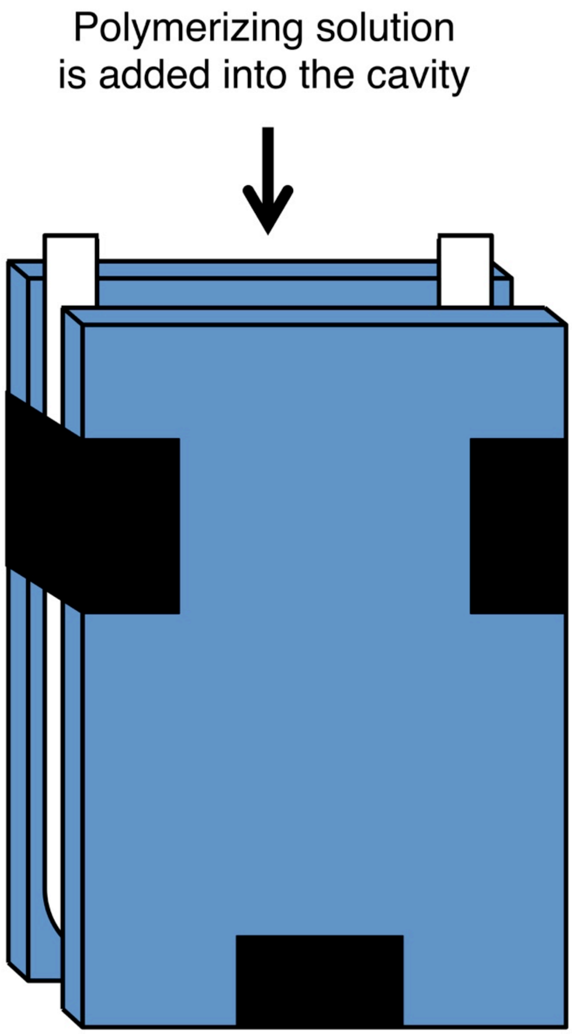


Figure 18: A cavity is formed between the glass plates. This is due to the inside loop of the "U" shaped silicone tubing.

After the polymerizing solution is cast into the mold, a length of silicone tubing is inserted into the top of the mold, sealing it, as shown in Figure 19. The mold is then submerged into an oil bath, taking care not to submerge the top of the mold or else contamination by the oil bath is possible. The solution is allowed to polymerize for an additional 24 hours, at which point the metal clamps are removed, releasing the sheet of cured plastic within. After use, the silicone tubing may need to be replaced, depending on the quality of silicone tubing used.

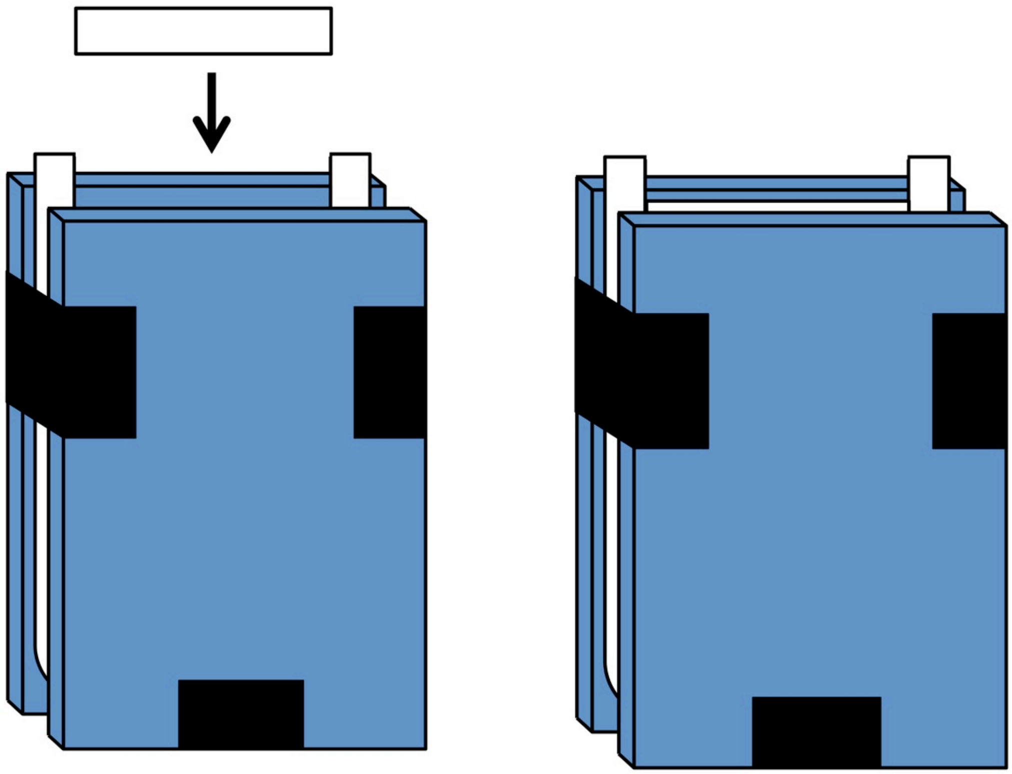

Figure 19: A length of tube is inserted into the top of the mold. This seals the mold to reduce evaporation during polymerization.

# 4. α-ZIRCONIUM-PHOSPHATE/PMMA NANOCOMPOSITES

## 4.1 Introduction

Annually, household fires cause 7 billion dollars worth of damage to property in the United States[1]. Fortunately, this number is decreasing due in part to continuous advances in material flammability and firefighting procedures. In order to drive down fire losses even further, problem areas must be identified, and mitigation strategies must be developed. One area of improvement is in realm of polymers. Polymeric materials are inexpensive, lightweight, and high strength, leading to their widespread integration into industrial and household applications. Since nearly all polymers are hydrocarbon-based, they provide an energy-rich fuel source in the event of a fire, making the mitigation of polymer flammability key in reducing fire losses.

In the last half of the 20$^{th}$ century, an array of polymeric additives was developed to increase flame-retardancy and thermal stability of polymeric materials. Some of the most common flame-retardant additives, such as TDCPP and penta PDE's, are proven mutagens and neurotoxins in lab mice, highlighting the need for new effective non-toxic flame-retardant polymeric additives[10-12].

Flame-retardant polymer nanocomposites, generally consisting of inorganic nanoparticles dispersed in a polymeric matrix, have gained significant attention in the last three decades for their ability to form and maintain a protective barrier when burned. As a flame-retardant polymeric nanocomposite burns, thermal degradation products form a protective barrier on the surface of the material. The barrier consists mainly of carbonaceous char, formed during the degradation process, and inorganic nanoparticles, agglomerated together on the surface of the material[13-19].

The interactions between inorganic nanoparticles and polymeric matrices are complex, including complex dispersion patterns and unique surface reactions at the polymer nanoparticle interface. As a result, previous research has focused on studying the thermal degradation of various inorganic nanoparticles in search of more effective additives. Some of the most common additives observed in literature include montmorillonite, nanosilicas, aluminas, and carbon nanotubes[29-31]. However, only limited work has been done with the phosphorous-rich, easily customizable nanoparticle, alpha-zirconium phosphate (ZrP)[32]. This study focuses on embedding ZrP into poly (methyl methacrylate) (PMMA) using a simple synthesis route, and observing any changes to morphology and thermal degradation. Furthermore, the synthesis route used allows a wide range of ZrP loadings to be achieved while simultaneously maintaining the optical transparency of PMMA, producing novel transparent nanocomposites with high ZrP content.

## 4.2 Experimental Methods

### *4.2.1 Materials*

Poly(methyl methacrylate) (PMMA, typical average $M_W$ = 35,000 Da) beads and anhydrous n-propanol (99.5%) were purchased from Fischer Scientific. Concentrated orthophosphoric acid (85%) and N,N-dimethylformamide (DMF, 99.8%) was purchased from Sigma Aldrich. Zirconium propionate was supplied by Magnesium Elektron Ltd., England.

### *4.2.2 Preparation of ZrP Suspensions in DMF*

Preparation of a ZrP gel intercalated with alcohol follows a method modified from Pica *et al* [33]. The procedure involves dissolving 3.3 mmol of zirconium propionate in a 10 mL of anhydrous n-propanol. Under stirring, 1.35 mL of concentrated phosphoric acid is added quickly to the solution, resulting in a viscous solution after a few seconds. The resulting viscous nanoparticle solution is washed in DMF several times to remove unreacted reagents and replace n-propanol with DMF. The ZrP suspension consists of small, 40nm wide, nanometer-thick nanoplates, intercalated by alcohol. Since the nanoparticles are small and already suspended, high loadings of ZrP in PMMA can be achieved.

#### *4.2.3 Preparation of ZrP/PMMA Nanocomposites*

Nanocomposites were produced in the range of 0wt% to 30wt% ZrP in PMMA. This is accomplished by first mixing a solution of PMMA (15wt% PMMA in DMF) with an appropriate amount of ZrP suspension in DMF for 15 minutes. The solution is sonicated for 15 minutes before being cast onto tin foil-lined glass dishes. Samples were dried at 100°C for 24 hours after which the foil was removed from the dried sample to produce a single free standing ZrP/PMMA nanocomposite film.

#### *4.2.4 Material Characterization and Analysis*

X-ray diffraction was used to better understand the morphology of the prepared ZrP/PMMA composites. Measurements were obtained for the various samples using a Bruker D8 Discover X-ray Diffractometer with Cu-$K_{\alpha}$ source ($\lambda$ = 1.54178 Å). Instead of using free-standing films for XRD measurements, thin film samples were cast directly onto ground glass substrates and dried in the same conditions as the free-standing films. UV-visible spectroscopy was performed to observe how ZrP loading affects nanocomposite transparency. This was done using a Hitachi U-4100 UV-vis-NIR spectrophotometer with tungsten and deuterium lamps from 250 nm to 900 nm with air as a baseline. Films for this test were controlled to have a thickness of 200 microns as measured by a standard micrometer. Thermogravimetric analysis was used to observe the thermal stability of various nanocomposites. Measurements were obtained using a

TA Instruments Q500 Thermogravimetric Analyzer with a heating rate of 10°C per minute in an air atmosphere from 30°C to 800°C. Nanocomposite films were powderized for this test for convenience. Differential scanning calorimetry was used to measure the glass transition temperatures of nanocomposites with various ZrP loadings. This was done using a TA Q200 Differential Scanning Calorimeter under nitrogen flow and a heating rate of 20°C per minute from 30°C to 200°C. Nanocomposite films were powderized in this test for convenience.

## 4.3 Results and Discussion

### *4.3.1 Nanocomposite Morphology*

XRD was used to study the internal morphology of the prepared nanocomposites. As seen in Figure 20, pure PMMA is amorphous with very broad peaks around 14 and 21°, corresponding to polymer chain-to-chain packing and intermolecular distances in PMMA, respectively [34]. At 5 wt% ZrP in PMMA, a peak appears at 8.30°, but since the peak associated with the layer-to-layer distance of agglomerated ZrP (7.6 Å, 11.6°) is not present, this peak indicates the presence of intercalated ZrP[32]. As the loading of ZrP in PMMA is increased further, the intercalation peak also increases indicating the concentration of intercalated ZrP increases with ZrP loading. Small peaks at 19.5°, 22.2°, 27.4°, and 33.9° approximately correspond to peaks found in literature for the intercalated ZrP gel: 20.1°, 22.0°, 29.1°, and 33.5°, respectively [35].

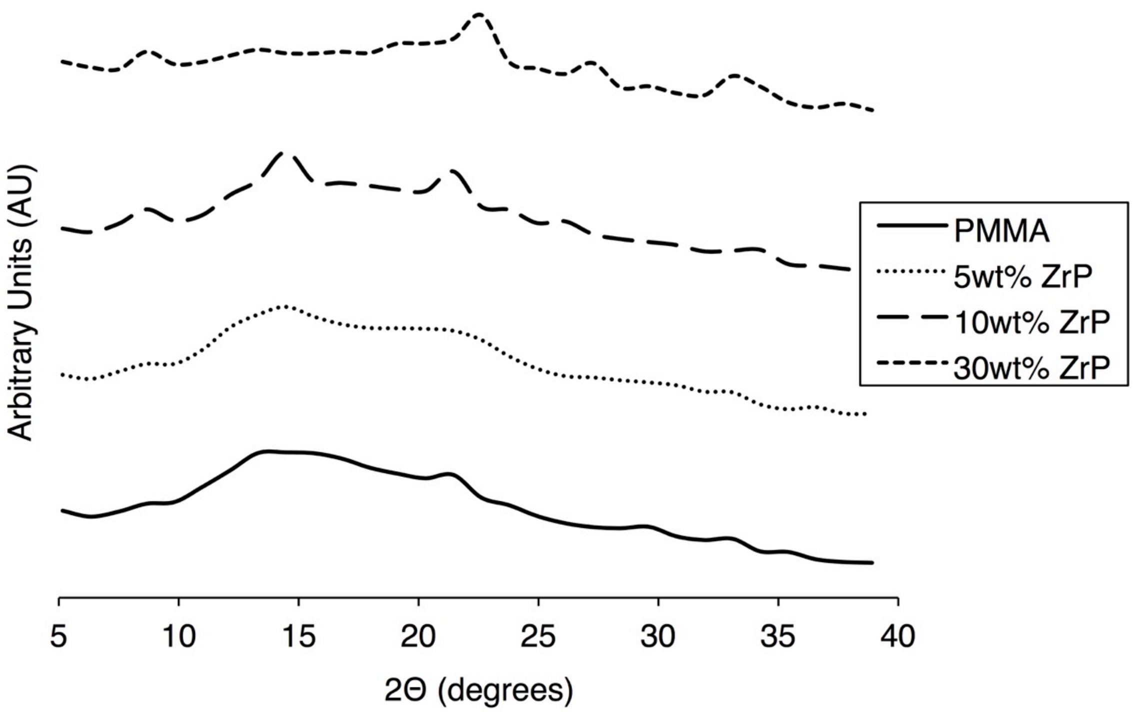


Figure 20: XRD measurements of ZrP/PMMA nanocomposites.

### *4.3.2 Optical Properties*

The effects of ZrP concentration on PMMA transparency and UV absorption was tested using UV-vis spectroscopy. To take into account the varying thickness of the nanocomposite samples, the corrected absorbance, (absorbance divided by the sample film thickness) is reported for wavelength range of 250nm to 700nm and shown in Figure 21.

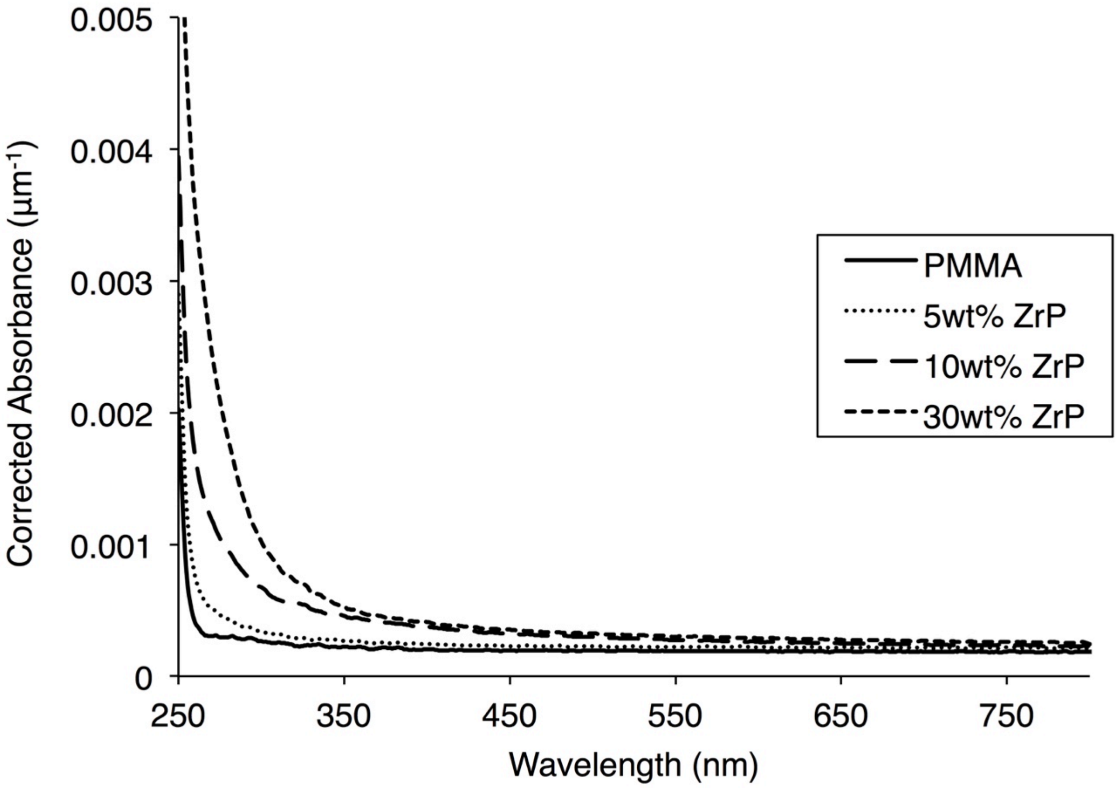


Figure 21: Corrected absorbance data for various ZrP loadings in PMMA.

It is apparent that even up to 30wt% ZrP, samples are remarkably transparent throughout the visible spectrum. Unlike many other PMMA nanocomposites, ZrP/PMMA nanocomposites are optically transparent even at the high ZrP loadings seen in this study. Figure 21 also shows that increasing ZrP content also increases UV scattering and absorption, similar to other metal oxides. This gives ZrP/PMMA nanocomposites the unique ability to remain optically transparent while rejecting significant amounts of UV light.

### *4.3.3 Thermal Stability Studies*

The thermal stability of the ZrP/PMMA nanocomposites was analyzed using TGA (Figure 22) and the corresponding DTG (Figure 23). The DTG data in Figure 23 shows there is one main degradation reaction for each sample. Since these studies were done in air, it is expected that PMMA will have a single, broad degradation reaction, as shown by Kashiwagi[25]. It is important to note that, although the general shapes of TGA curves in Figure 22 are similar, the corresponding DTG plots show a dramatic shift in the peak mass loss rate (PMLR) to higher temperatures (41°C higher), while simultaneously reducing the peak by 10%.

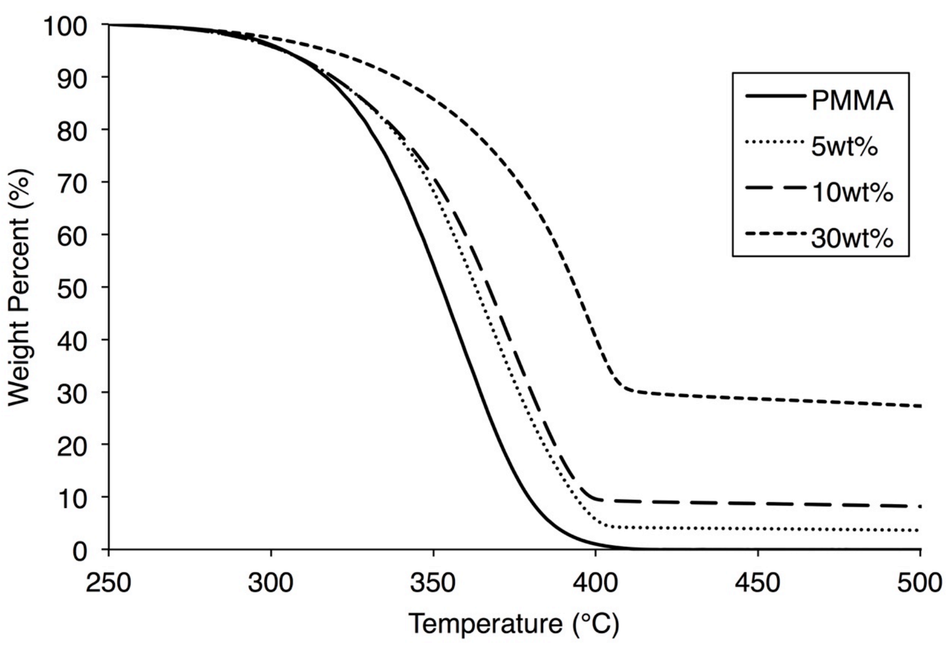


Figure 22: TGA measurements for ZrP/PMMA nanocomposites. Measured at a ramp rate of 10°C/min.

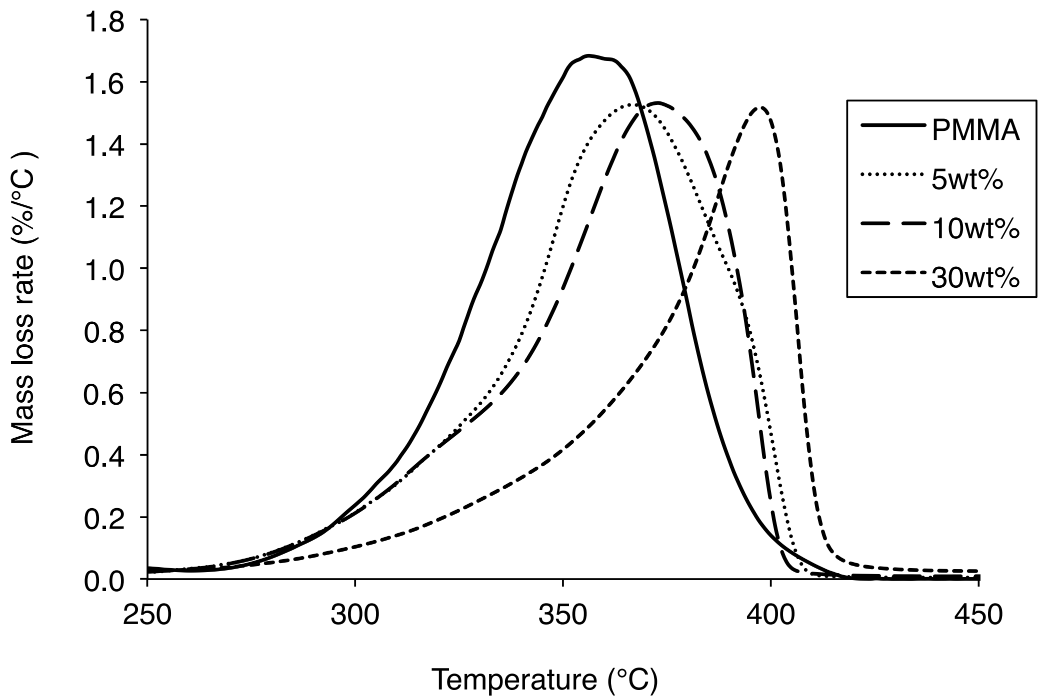


Figure 23: DTG measurements for ZrP/PMMA nanocomposites. Measured at a ramp rate of 10°C/min.

Table 1 summarizes the onset of degradation (temperature at 5% mass loss), the temperature at 25% mass loss, the temperature at 50% mass loss, and the temperature at the PMLR. Table 1 shows that the onset of degradation is affected slightly by the presence of ZrP, shifting it towards higher temperatures, for the 30wt% ZrP nanocomposite. The temperature for 25% mass loss and 50% mass loss are shifted dramatically by a maximum of 34°C and 41°C, respectively. Finally, the temperature at which the peak mass loss rate occurs is shifted upwards by 41°C, showing that the ZrP nanocomposites are significantly more thermally stable when compared to neat PMMA. Improvements to thermal stability are significant, even in comparison to other commonly used nanofillers such as montmorillonite, aluminum oxide, and beohmite particle (AlOOH)[13, 14]. It is possible the thermal stability effects are caused by a trapping mechanism or decreased polymer mobility due to nanofillers, similar to other nanocomposites[13].

Table 1: TGA Results

| Particle Loading (wt% ZrP) | Temperature at 5% Degradation (°C) | Temperature at 25% Degradation (°C) | Temperature at 50% Degradation (°C) | Temperature at PMLR (°C) |
|---|---|---|---|---|
| 0 | 304 | 335 | 352 | 356 |
| 5 | 303 | 343 | 363 | 366 |
| 10 | 304 | 346 | 368 | 374 |
| 30 | 317 | 369 | 393 | 397 |

The presence of high temperature residuals in Figure 22 suggests there is a dramatic enhancement in the retention of mass. The final mass of samples after TGA tests is summarized in Figure 24 and shows ZrP nanocomposites have enhanced residuals, due in part to their thermally stable inorganic ZrP content. This is one of the benefits of high loadings ZrP nanocomposites. Under normal conditions, ZrP nanoomposites look and act similar to a polymer, but in the event of a fire, the material is largely noncombustible. Compared to numerous other nanofillers in literature, the materials in this study provide superior high temperature residuals[13].

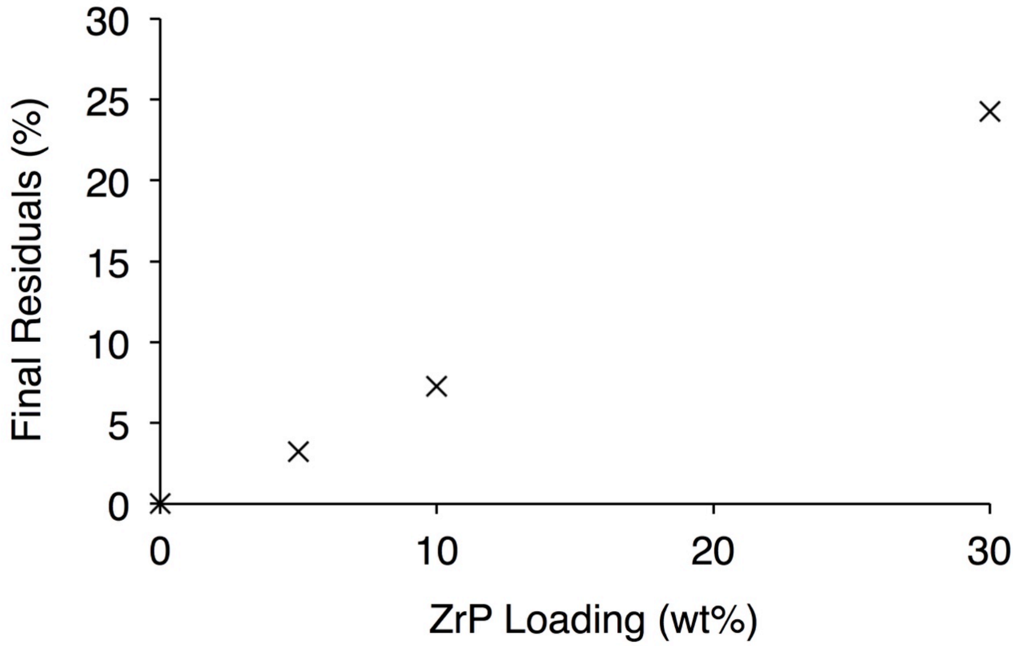


Figure 24: Residual mass after TGA tests.

### *4.3.4 Degradation Kinetics*

The TGA data was also used to determine the kinetics of the thermal degradation. By linearizing the TGA data, it is possible to determine the form of the kinetic mechanism as well as the activation energy for the reaction. For a first-order kinetic form, a linear mass balance can be written by combining Equation 2 and Equation 3 in *Section 1.4: Relevant Degradation Kinetics,* resulting in Equation 18.

$$ln\left[\frac{\left(\frac{d\alpha}{dt}\right)}{(1-\alpha)^n}\right] = \frac{-E_a}{RT} + lnA \tag{18}$$

According to Equation 18, if the ZrP/PMMA degradation abides by first-order kinetics, a plot of the inverse of T vs. $ln\left[\frac{\left(\frac{d\alpha}{dt}\right)}{(1-\alpha)}\right]$ should yield a straight line with the slope equal to $\frac{-E_a}{R}$. The resulting linearized plots for PMMA and 10wt% ZrP in PMMA are shown in Figure 25 and Figure 26, respectively. This indicates the single broad degradation reaction shown in PMMA and ZrP in PMMA can be described by a first-order pseudo-step reaction.

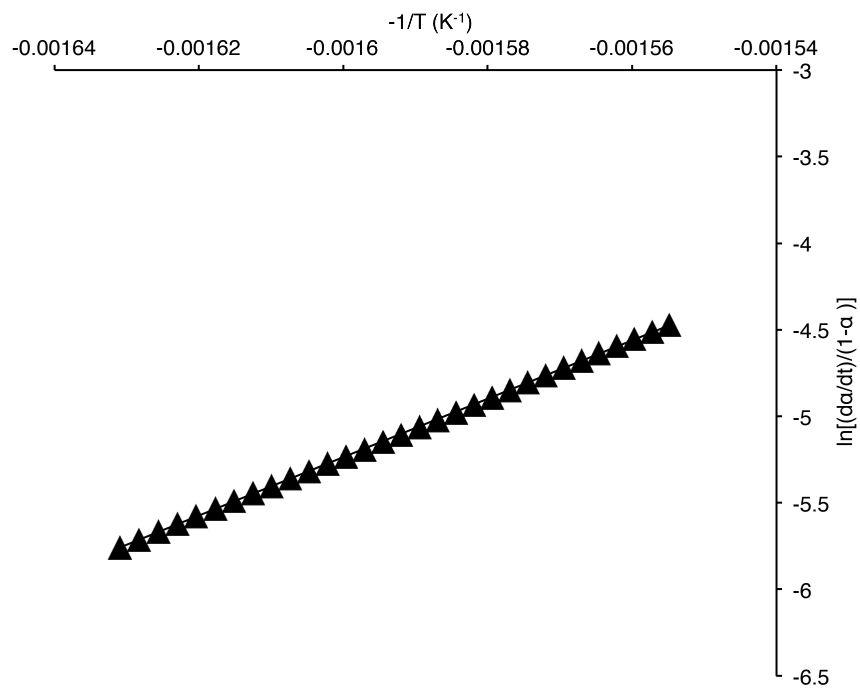


Figure 25: Linearization of TGA data for PMMA. Linearity provides evidence of a first-order reaction pseudo-step reaction.

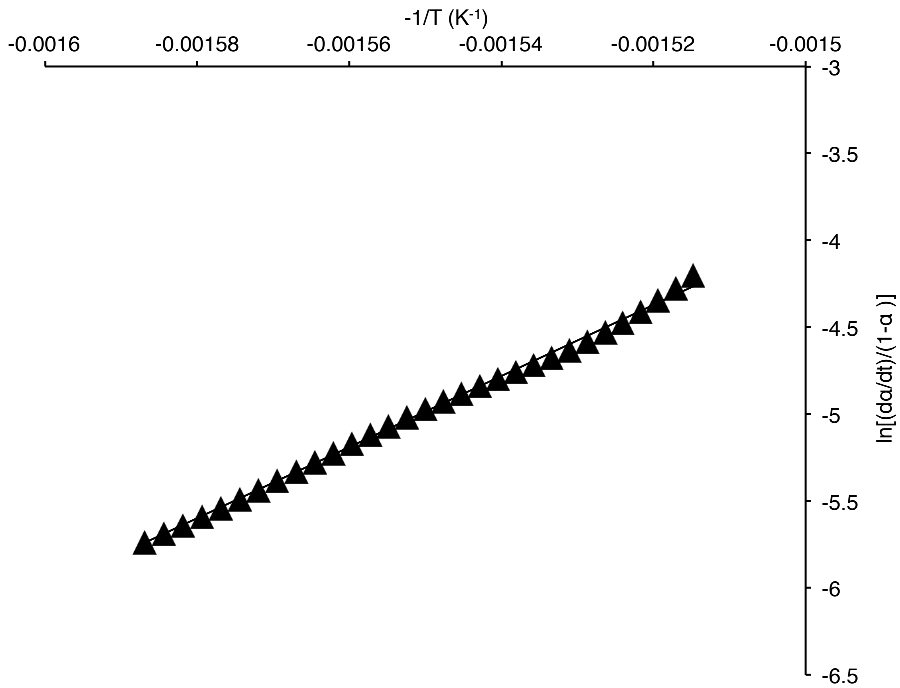


Figure 26: Linearization of TGA data for 10wt% ZrP in PMMA data. Linearity provides evidence of a first-order reaction.

From the slopes of the linearized data, the activation energies were determined and are shown in Figure 27. In general, the activation energy increases with ZrP loading, similar to other nanofillers. This is likely due to the reduction in polymer mobility or a radical trapping mechanism[13]. The increased activation energy from ZrP content shows that high loadings of ZrP can stabilize degradation reactions.

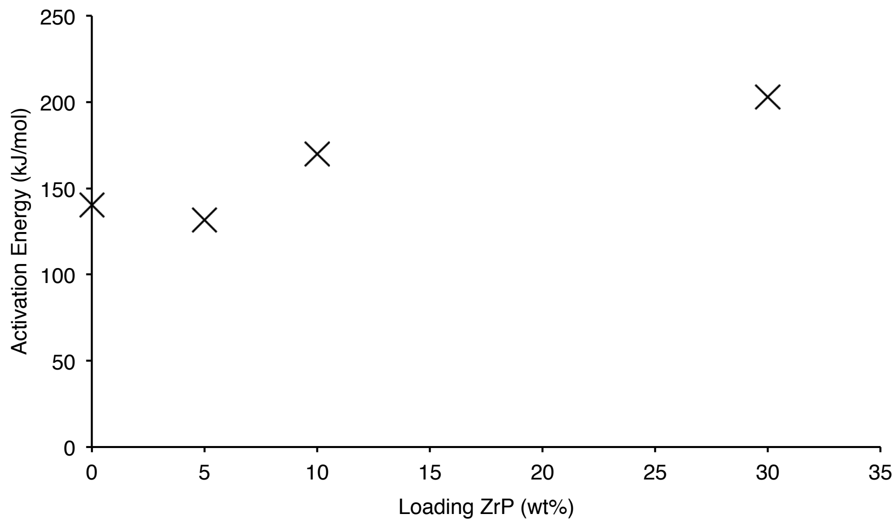


Figure 27: Degradation activation energy of PMMA with respect to ZrP loading.

#### *4.3.5 Glass Transition Temperature Effects*

Results from the DSC tests were used to understand how ZrP content affected glass transition temperatures and are shown in Figure 28. At loadings below 10wt%, addition of ZrP increases the glass transition temperature. Weight loadings greater than 10wt% ZrP begin to decrease the glass transition temperature.

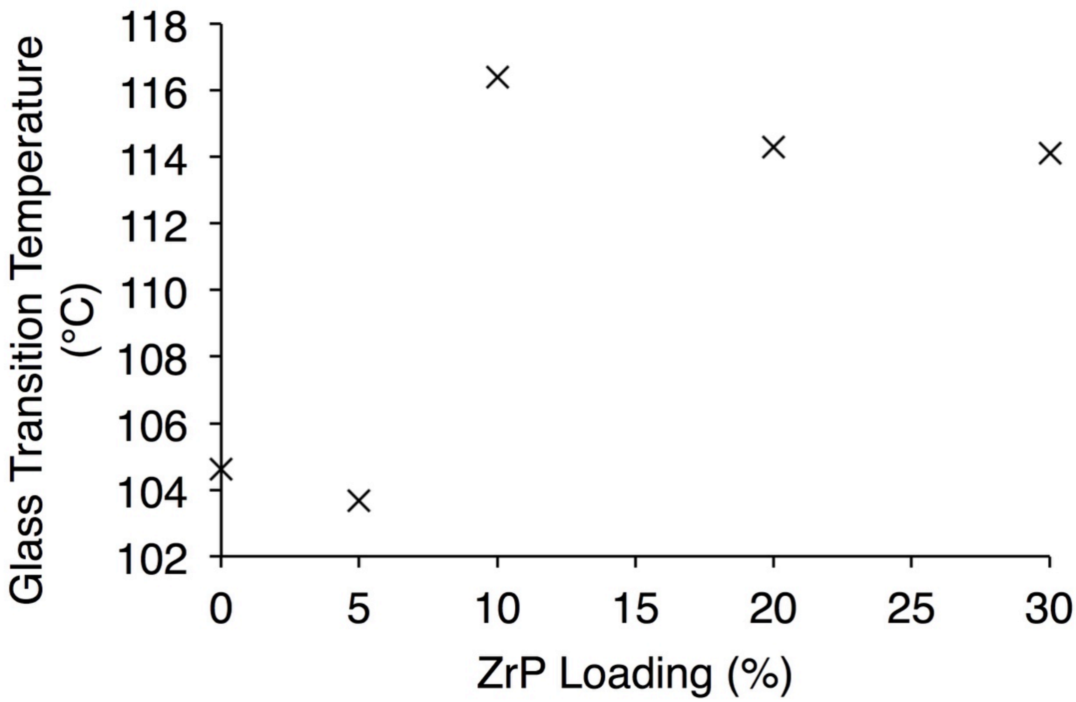


Figure 28: Glass transition temperature for various ZrP loadings in PMMA.

Literature suggests that exfoliated ceramic plates in PMMA decrease the mobility of polymer chains leading to an increase in the glass transition temperature[36]. Figure 28 shows a similar trend for the same range of nanofiller loading (below 5wt%). However, above 10wt%, the data show a decrease in glass transition temperature, which is most likely due to nanoparticle agglomeration. Large nanoparticle agglomerates act as a single particle, but contain many individual nanosheets, effectively reducing the number of individual particles seen by the polymer matrix. This effect decreases the glass transition temperature of the bulk material at higher loadings.

### 4.4 Conclusions

Nanocomposites of ZrP in PMMA with a wide range of nanoparticle loadings (0-30wt%) were produced using a mild synthesis process at room temperature followed by solution casting. The nanocomposites were homogeneous and showed excellent optical transparency while simultaneously scattering significant amounts of UV light. Thermal stability studies using TGA showed that all materials degrade in a single broad reaction when exposed to air. However, the peak mass loss rate (PMLR) for ZrP nanocomposites was reduced by 10% and shifted up 41°C when compared to neat PMMA, showing these nanocomposites possess enhanced thermal stability. Kinetic studies showed that ZrP enhanced the activation energy for PMMA degradation up to 60kJ/mol, further showing that ZrP/PMMA nanocomposites have greather thermal stability than PMMA. In addition, the high loading of the ZrP nanocomposites in this study allow for increased residuals at high temperature. This means that ZrP nanocomposites can be used in traditional polymeric applications, but in the event of a fire, are largely noncombustible. Lastly, DSC test showed the glass transition temperature does change with respect to ZrP loading, but the maximum difference observed was only 12°C, indicating that the application of ZrP nanocomposites should not be hindered by their glass transition.

# 5. PMMA NANOCOMPOSITES WITH SILICA CROSS-LINKAGES*

## 5.1 Introduction

Combatting the hazards associated with fires in the home and workplace is an ongoing effort requiring constant reevaluation and improvement of fire safety procedures and technologies. Damage to homes in the United States due to fires dropped from $10.2 billion/year in 1977 to $7 billion/year in 2011, due partially to improved fire safety standards and fire-mitigation technologies[1]. Despite the decreasing trend, the National Fire Protection Association reports that 56% of fire deaths are of individuals above the age of 50, suggesting that a disproportionate number of individuals in older demographics fall victim to house fires[2]. These data make it apparent that there is need for passive flame-retardants.

One important realm of flame-retardant research is in polymeric materials. Since the middle of the 20th century, the use of polymers in the home and industry has skyrocketed. However, in the event of a fire, the energy-dense hydrocarbon composition of polymers provides a source of fuel, making their widespread application an item of concern.

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In response, an immense amount of research has focused on reducing the flammability of polymeric materials. One early research focus was into halogenated flame-retardants, which degrade into radical scavenging products that quench free-radical reactions in the vapor phase[3]. These materials are often paired with a synergistic additive such as antimony oxide or a phosphorous-based flame-retardant to enhance char formation[4]. Some of the most common halogenated flame-retardants include tetrabromobisphenol A derivates, polybrominated diphenyl ethers, and polybrominated biphenyls, among others[5].

Another focus of research has been on phosphorous-based flame-retardants. Various phosphorous-based materials have been developed and incorporated into polymers, resulting in dramatic improvements to flammability[6]. Generally the efficacy of phosphorous-based approaches is due to the formation of char from degraded polymer and in some cases, the generation of vapor, which can dilute or quench gas-phase reactions[7]. Furthermore, vapor generation in phosphorous-based flame-retardants can help increase the volume of produced char, producing thick, expanded, intumescent barriers[6]. Examples of phosphorous-based flame-retardants include various types of ammonium polyphosphate and triphenyl phosphate, among many others[8]. Halogenated phosphorous-based materials also exist, including tris(2-chloro-ethyl) phosphate and tris(chloropropyl)phosphate, which take advantage of both halogenated and phosphorous-based approaches[8].

Phosphorous-based materials are only one type of intumescent flame-retardant. Generally, intumescent systems involve the incorporation of a charring agent, a source of carbon for the charring agent, and a blowing agent to generate vapor, which increases the volume of the char to produce a thick insulating physical barrier. Some state-of-the-art flame-retardants incorporate all three of these materials into a single intumescent additive, such as in studies with melamine salts of pentaerythritol phosphate or the familiar deoxyribonucleic acid (DNA)[6]. In addition, significant research focuses on combining intumescent flame-retardant systems with nanofillers in an effort to reinforce char and create a high quality, continuous barrier[6].

However, some of the most commonly used flame-retardants have received criticism due to their toxicity or environmentally persistent nature. Many halogenated flame-retardants have been phased-out by manufacturers, including pentabrominated diphenyl ethers (pentaBDEs), which accumulate in ecosystems where they are difficult to remove[9]. Some phosphorous-based materials have been shown to pose environmental concerns, being found in significant concentrations in the environment[8]. Furthermore, many halogenated phosphorous-based flame-retardants are potentially toxic, such as tris (1,3-dichloroisopropyl) phosphate (TDCPP) which been shown to be a neurotoxin in mice cells and a mutagen for animals[10-12].

One technology that has the potential to replace potentially toxic and environmentally persistent flame-retardants is the polymeric nanocomposite. These materials, which are traditionally composed of a polymeric matrix embedded with inorganic nanoparticles, possess high thermal stability and in some cases, the ability to produce a physical barrier at the burning surface of the material[13-17]. The barrier that forms consists mainly of accumulated, thermally-stable inorganic nanoparticles and carbonaceous char which act as shield, reducing mass and heat transport to the incident flame, while protecting unburned material behind the barrier[18, 19].

As with intumescent flame-retardants, a trend in previous research is to focus on how conventional flame-retardants interact with nanofillers to synergistically enhance the formation of a physical barrier, measured in part by an increase in high temperature residuals[37-43]. Many different conventional flame-retardants have been utilized in conjunction with nanofiller, including phosphorous containing compounds such as polyphosphoric acid, Friedel-Craft reagents such as phosphotungstic acid, or other chemically active additives[37-41].

Polymer cross-linking can be used to increase the char yield of polymers as well as dramatically reduce internal mass transfer compared to linear polymers, but little has been done to directly quantify the interactions between common polymer cross-linking and nanocomposite degradation[44]. Furthermore, modern chemistry allows for the surface treatment and customization of silica nanoparticles, transforming them into cross-linking agents. Specifically, nanosilica can be surface treated with KH570, introducing many vinylidene groups ($RC{=}CH_2$) to the surface of the nanosilica. These surface vinylidene groups can participate in free-radical polymerization, incorporating into growing polymer chains. The results are polymeric nanocomposites with silica-based cross-linkages, synthesized without the use of a separate cross-linking agent. Since methyl methacrylate (MMA), the monomer of poly(methyl methacrylate) (PMMA) closely resembles the active KH570 surface treatment, polymerization is more likely than with other dissimilar monomers, making PMMA a good polymer candidate for this study.

## 5.2 Experimental Methods

### *5.2.1 Materials*

Methyl methacrylate monomer (MMA) and 1,1'-Azobis(cyclohexanecarbonitrile) (ABCN) initiator were supplied by Polysciences. Nanosilica (average diameter of 20-30nm) was supplied by US Nano with two different surface treatments. One treatment, KH550, does not participate in polymerization reactions and was used for linear PMMA nanocomposites, while the second treatment, KH570, does participate in polymerization reactions, and was used to produce silica cross-linked nanocomposites. Both nanosilicas contain 3 wt-% to 4 wt-% surface treatment, as confirmed by per-batch elemental analysis by the vendor.

### *5.2.2 Nanocomposite Synthesis*

MMA was placed into a glass vial with silicone septum and PTFE liner, which acts as a polymerization vessel. An appropriate amount of silica surface-modified with KH570 was added to the monomer to make one of four loadings as follows: neat PMMA, 1 wt-%, 2 wt-%, or 4 wt-% silica in MMA. As previously discussed, the KH570 silica surface functionalization can be polymerized with multiple PMMA chains to form a cross-linked material. The solution was stirred with a magnetic stirrer for 30 minutes, after which the solution was sonicated at room temperature for 30 minutes to degas and complete mixing. An amount of ABCN is added to the mixture corresponding to 0.2 wt-

% ABCN solution in MMA. Under gentle stirring, nitrogen is bubbled through the solution for 10 minutes to inert the polymerization vial and reduce the dissolved oxygen concentration. The vial is submerged into a mineral oil bath which is maintained at 70°C ± 1°C. A hot plate provides heat and gentle magnetic stirring to both the oil bath and a small magnetic stirrer in the polymerization vial.

### *5.2.3 Casting Nanocomposites*

Just prior to the solution gelling, the solution is cast into multiple 2 mL sealable polypropylene vials. Each vial, fitted with a piece of buoyant foam, is allowed to float in an oil bath at 70°C ± 1°C for an additional 24 hours to finalize curing, after which samples are removed from the polypropylene vials. Sections of cross-linked samples were placed in acetone for several hours to assure solvent-swelling behavior, indicating the presence of polymer cross-linkages.

In the case of Cone Calorimetry samples, instead of casting nanocomposites into a small polypropylene vial, polymer solutions are transferred to a specialized polymerization mold, developed from previously used methods[45]. The mold was designed to produce panels of nanocomposite material which were cut into 10cm x 10cm x 0.5cm samples for Cone Calorimetry testing. The mold consists of a length of silicone tubing, sandwiched between two panes of glass, forming a cavity between the panes. Small metal clamps are applied across the surface of each glass plates to keep the silicone tubing in place and to assure the mold does not leak. The polymerization solution is poured in the top of the cavity formed between the glass panels, and an additional piece of silicone tubing is used to seal the top of the mold. The entire apparatus is then submerged into a large, well-mixed oil bath at 70°C ± 1°C for an additional 24 hours. The final thickness of the sample is defined by the thickness of the silicone tubing and the force applied to the glass panels by the metal clamps. After curing is complete, the mold is removed from the oils bath and thoroughly cleaned. The metal clamps are then removed, allowing the glass plates to separate, releasing the cured sample within. This molding process produces well-formed polymeric sheets and removes the need for expensive specialized ovens to prepare Cone Calorimetry samples.

Using the large Cone Calorimetry mold, neat PMMA and 1 wt-% silica cross-linked samples were tested. In addition, traditional 1 wt-% silica nanocomposites were produced to compare the flammability of material in this study to more traditional silica/PMMA nancomposites. Traditional linear nanocomposites are made using the synthesis methods already discussed, except instead of surface treating silica with KH570, silica is treated with KH550, which does not engage in free-radical polymerization.

### *5.2.4 Material Characterization and Analysis*

Scanning Electron Microscopy (SEM) was used to characterize the surface-treated nanoparticles before being embedded by first dispersing the nanosilica in isopropyl alcohol and then applying it to a substrate, followed by the evaporation of isopropyl. Thermogravimetric Analysis (TGA) and Derivative Thermogravimetric Analysis (DTG) were done using a Texas Instrument Q50 Thermogravimetric Analyzer. Nanocomposite samples prepared for TGA consisted of neat PMMA, or a nanocomposite containing 1 wt-%, 2 wt-%, or 4 wt-% nanosilica cross-linked to PMMA. Each TGA sample had a mass of approximately 3-5mg and was tested at a temperature ramp rate of 10°C/min or 20°C/min in an aluminum pan. TGA results were also used with three kinetic methods to determine the activation energy and kinetic form of degradation. X-Ray Diffraction (XRD) studies were done using a Bruker D8 powder diffractometer and Cu k-α as a radiation source. Nanocomposite samples were ground into a coarse powder for these XRD tests. Lastly, flammability and combustion experiments were conducted using a Fire Testing Technology Cone Calorimeter, with an external heat flux of 50 $kW/m^2$. Neat PMMA, traditional 1 wt-% silica in linear PMMA nanocomposites, and 1 wt-% silica cross-linked to PMMA nanocomposites were tested using these Cone Calorimetry methods.

## 5.3 Results and Discussion

### *5.3.1 Nanocomposite Morphology*

Before being used in nanocomposites, the surface treated nanosilica was characterized using SEM, as shown in Figure 29 for a KH570 surface treated nanosilica. The spherical nanosilica appears to be reasonably uniform, with a diameter of 20-30nm. The SEM images show that the silica appears in small agglomerated clusters alongside a number of individual particles. The morphology of silica surface treated with KH550 appeared similar to silica treated with KH570, being essentially indistinguishable.

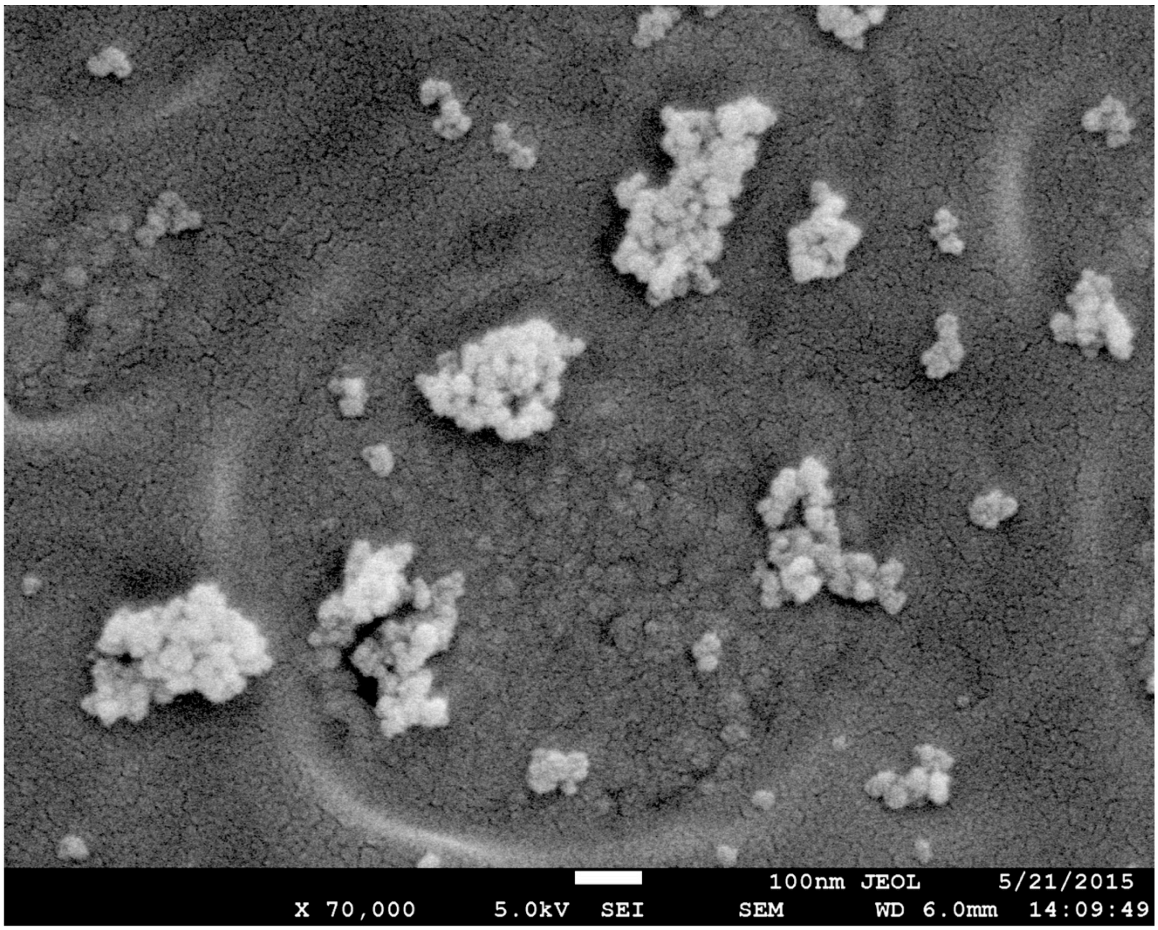


Figure 29: SEM image of KH570 modified nanosilica.

X-Ray Diffraction measurements were used to better understand the morphology of the cross-linked silica nanocomposites. XRD is particularly useful for observing significant mass fraction of agglomerated particles. As seen in Figure 30, the XRD plots for each nanocomposite sample look similar when compared to pure PMMA, except the peaks are broader and shifted slightly towards higher 2Θ values, indicating a slightly denser material. These results are consistent with other XRD measurements for PMMA[34]. The first broad peak near 2Θ = 14°C corresponds to chain-to-chain lengths in PMMA while the second broad peak near 2Θ = 30°C corresponds to intermolecular lengths within each PMMA repeat unit. The data in Figure 30 show each sample is essentially amorphous, suggesting that agglomeration is not a major issue.

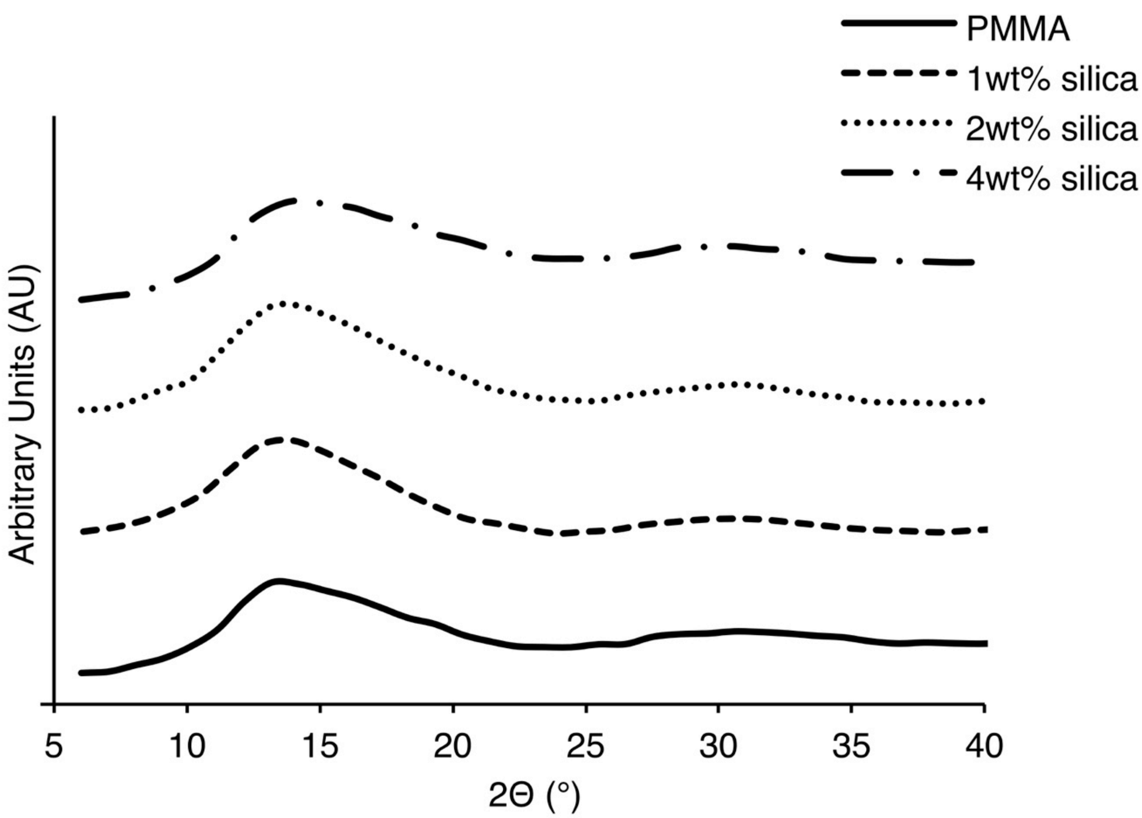


Figure 30: XRD results. Results for pure PMMA, 1 wt-%, 2 wt-%, and 4 wt-% silica cross-linked to PMMA.

### *5.3.2 Thermogravimetric Analysis*

The results for TGA and DTG at a ramp rate of 10°C/min are shown in Figure 31 and Figure 32, respectively. The TGA and DTG results for a ramp rate of 20°C/min have similar shapes when compared with Figure 31 and Figure 32, but with shifted degradation regions, as expected. In general, the degradation of PMMA in air occurs in a single broad mass loss step, shown as a mass loss peak in Figure 32. This is in good agreement with previous TGA measurements of PMMA degradation in air[25]. In addition, the DTG data in Figure 32 show that increasing nanoparticle concentration reduces the peak mass loss rate (PMLR), resulting in a maximum reduction of 30% for a 4 wt-% cross-linked nanocomposite, comparable to the results of a 13 wt-% traditional silica nanocomposite from literature[46]. These results indicate that silica cross-linkages enhance the thermal stability of PMMA significantly, allowing for a reduced mass of silica to be used.

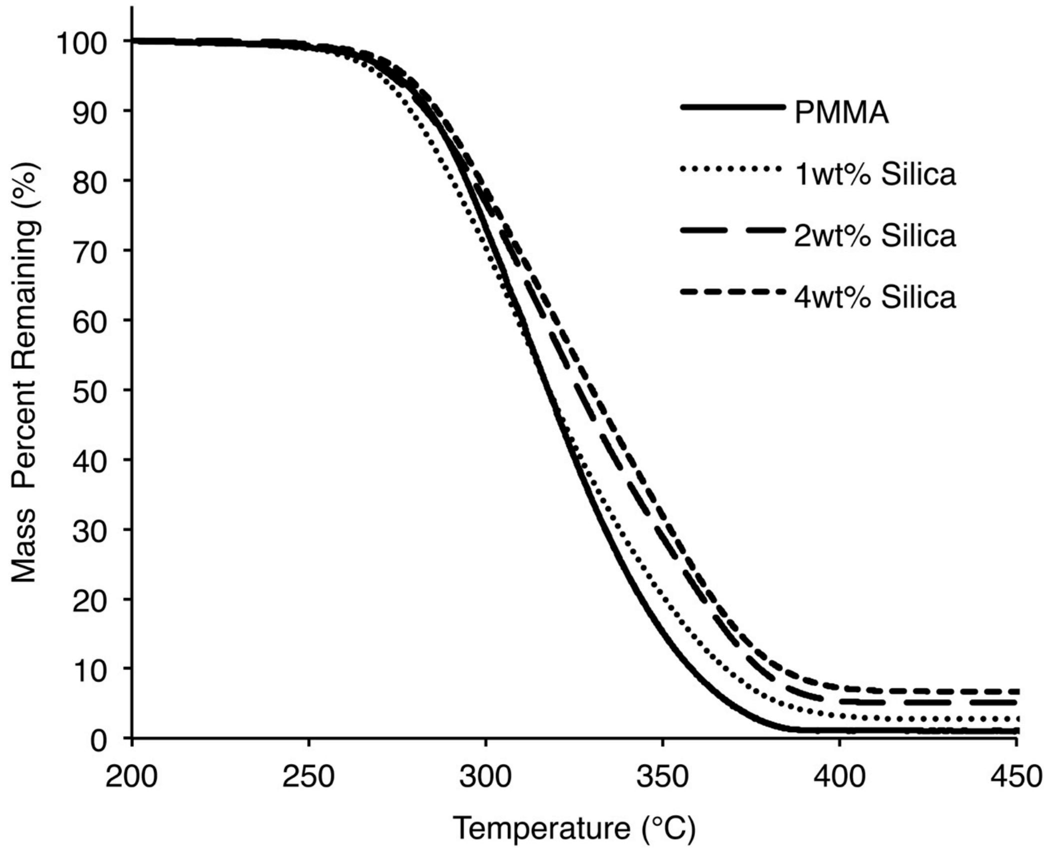


Figure 31: TGA results. Results for cross-linked silica loadings between 0wt% to 4wt%. Measured at a ramp rate of 10°C/min.

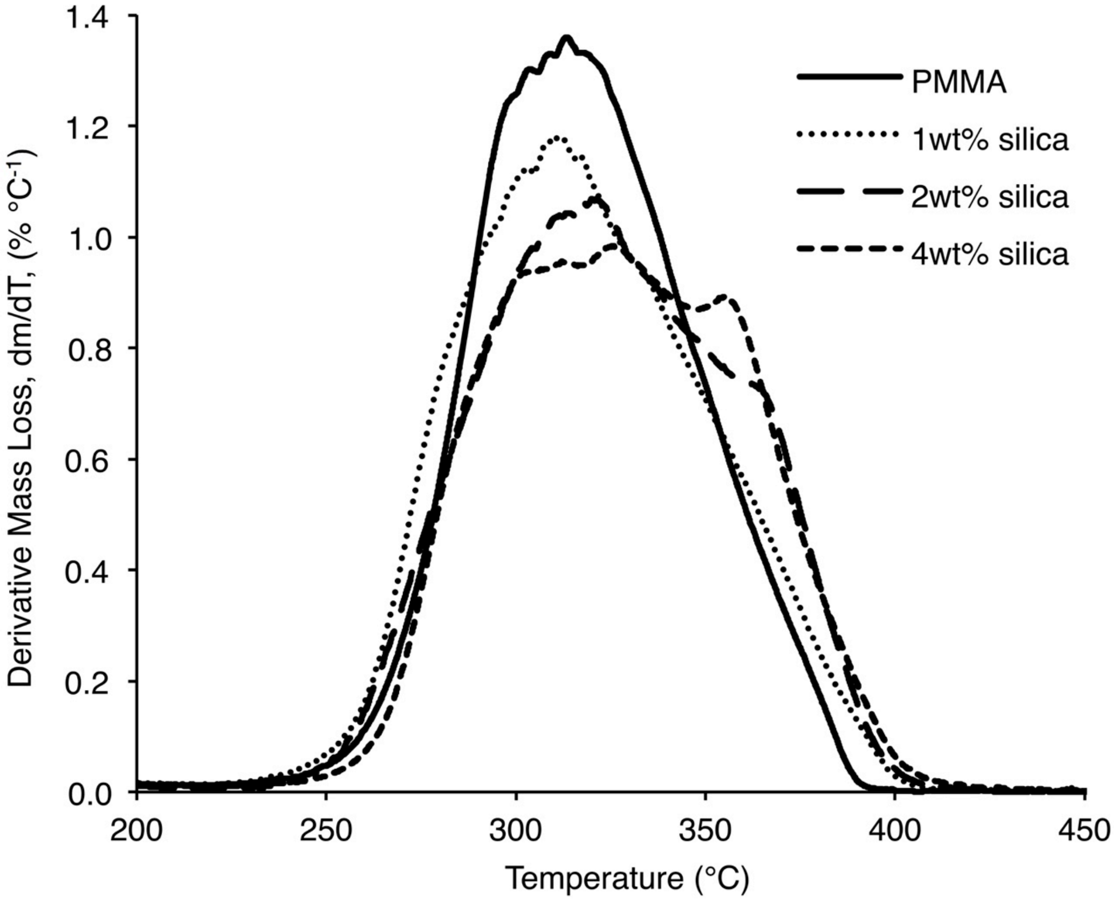


Figure 32: DTG results. Results for cross-linked silica loadings between 0wt% to 4wt%. Measured at a ramp rate of 10°C/min.

### *5.3.3 Degradation Kinetics*

Thermal degradation kinetics were first used to determine a suitable pseudo-step kinetic form. Since PMMA is often cited as following first-order pseudo-step degradation, a method for n-th order reactions was first used. In *Section 4: α –Zirconium Phosphate/PMMA Nanocomposites*, it was shown that combining the mass balance found in Equation 2 in *Section 1.4: Polymer Degradation Kinetics*, and the n-th order kinetic form, shown in Equation 3 of *Section 1.4: Relevant Polymer Degradation Kinetics*, resulted in Equation 18.

According to Equation 18, if the inverse of $T$ is plotted against the left side of Equation 18 and a straight line is achieved, the degradation can be described by a single first-order pseudo-step reaction. The results from this analysis, shown in Figure 33, produce a set of straight lines for the majority of the degradation, suggesting PMMA and all silica cross-linked PMMA samples are largely explained by a first-order reaction. However, at high degree of conversion, degradation becomes more complex and is not well described by a single kinetic form.

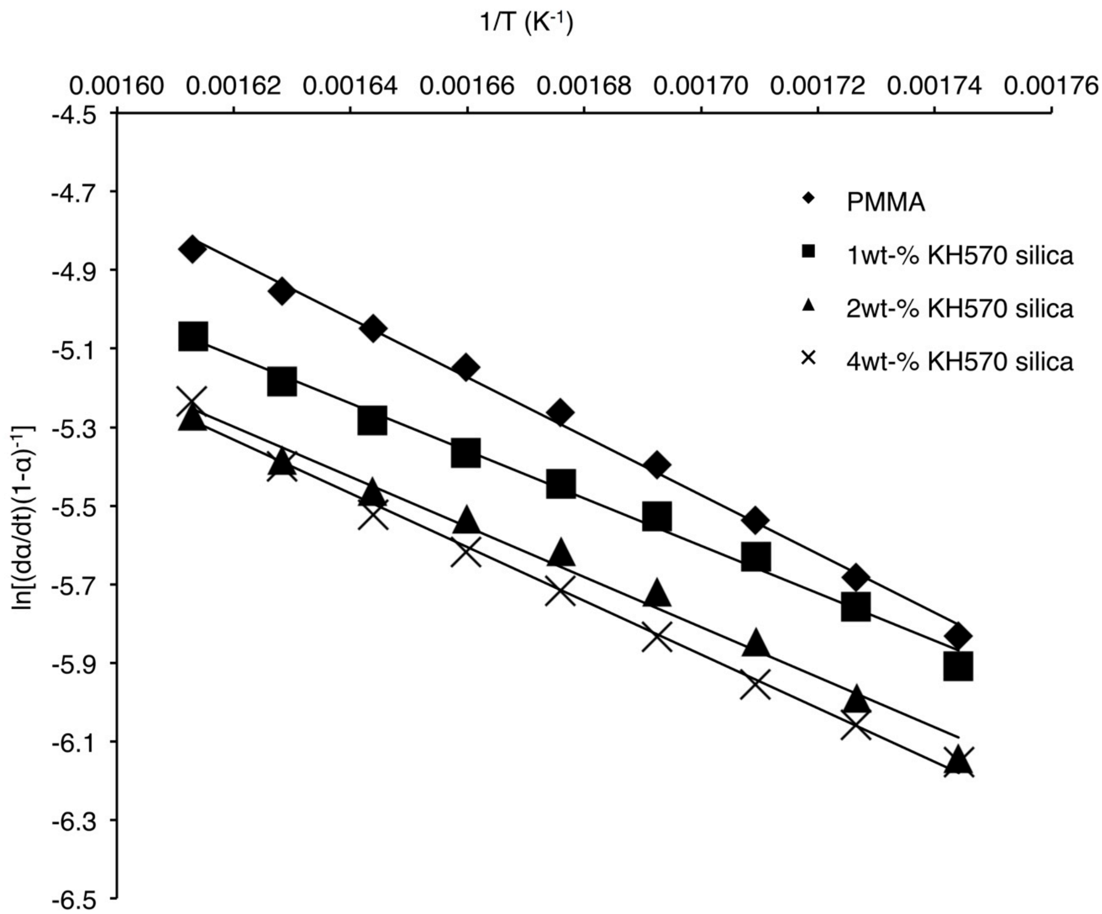


Figure 33: Linearized TGA data for PMMA and different loadings of KH570 silica. A linear plot indicates the reaction is well described by first order kinetics.

Since single-sample methods are sometimes unreliable for determining kinetic parameters, two model-free kinetic methods were chosen to calculate the activation energy of thermal degradation. The first method, developed by Friedman, is shown in Equation 15 in *Section 1.4: Relevant Polymer Degradation Kinetics* and assumes Arrhenius Rate Laws. The second method, developed by Kissinger, Akahira, and Sunose, then modified by Starink, assumes Arrhenius Rate Laws and uses an integral approximation. The resulting linear equation is shown in Equation 17 in *Section 1.4:*

*Relevant Polymer Degradation Kinetics*. Both the Kissinger-Akahira-Sunose, and the modified Starink methods linearize data across multiple temperature ramp rates, making parameter determination more reliable than single-sample methods.

Using these two kinetic methods, the activation energy was determined with respect to degree of conversion. Both methods provide good agreement with each other and show that activation energy appears to increase with respect to particle loading, summarized in Figure 34. The differences between pure PMMA, 1 wt-%, 2 wt-%, and 4 wt-% nanosilica in Figure 34 are dramatic, showing an increase in the activation energy by a factor of roughly two. Compared to conventional silica in PMMA previously studied, the activation energy is markedly improved with the nanocomposites presented here. Similar kinetic methods with traditional silica-PMMA previously showed an enhancement of roughly 20-50 kJ $mol^{-1}$ for similar silica loadings, while the nanocomposites in this study show that covalently bonded nanosilica enhanced activation energy by roughly 100 kJ $mol^{-1}$, dramatically stabilizing degradation reactions and producing more thermally stable materials[47]. In general, traditional nanofillers have a stabilizing effect on polymers due to a reduction in polymer mobility and free-radical capturing by silica, measured as an increase in the activation energy of degradation[13]. The enhanced thermal stability is attributed to reduced polymer mobility and free-radical trapping by silica, similar to traditional PMMA-silica nanocomposites[13]. However, the effect in this case is more pronounced, producing higher activation energies. This is attributed to increased interaction between nanofiller and polymer by covalent bonds.

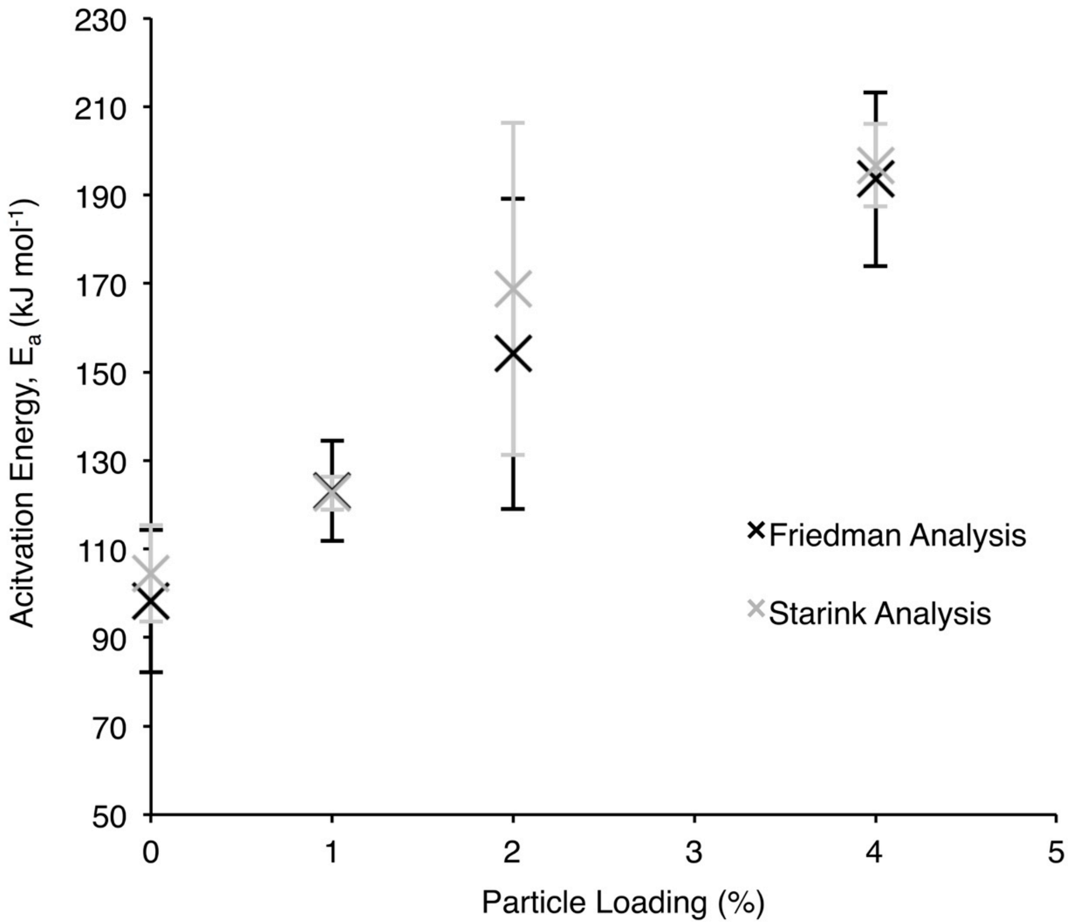


Figure 34: Activation energy for thermal degradation. Shown with respect to particle loading. Error bars indicate the standard deviation of the samples.

The final, high-temperature residuals from TGA and DTG tests were also examined. An increase in the mass of high temperature residuals is beneficial for forming a physical barrier as the material burns. In addition, increased residuals are often due to incomplete combustion, meaning less volatile fuel leaves the condensed phase to burn in a fire, remaining as thermally inert char. As shown in Figure 35, the residual mass after testing was greater than the sum of the pure PMMA char and the inorganic filler combined for all nanocomposites, indicating an increase in char yield due to silica. Furthermore, the cross-linked silica nanocomposites studied in this work appear to produce more char than traditional silica nanocomposites in other studies, indicating there are most likely contributions from both cross-linkages and nanofiller[48]. This effect is attributed to the decreased mass transport caused by polymer cross-linkages, shown previously in polymers without nanofiller[44]. By reducing the internal mass transport within the material, reaction intermediates spend more time on the interior on the material, closer to the nanoparticle-polymer interface at which char forming reactions occur[49].

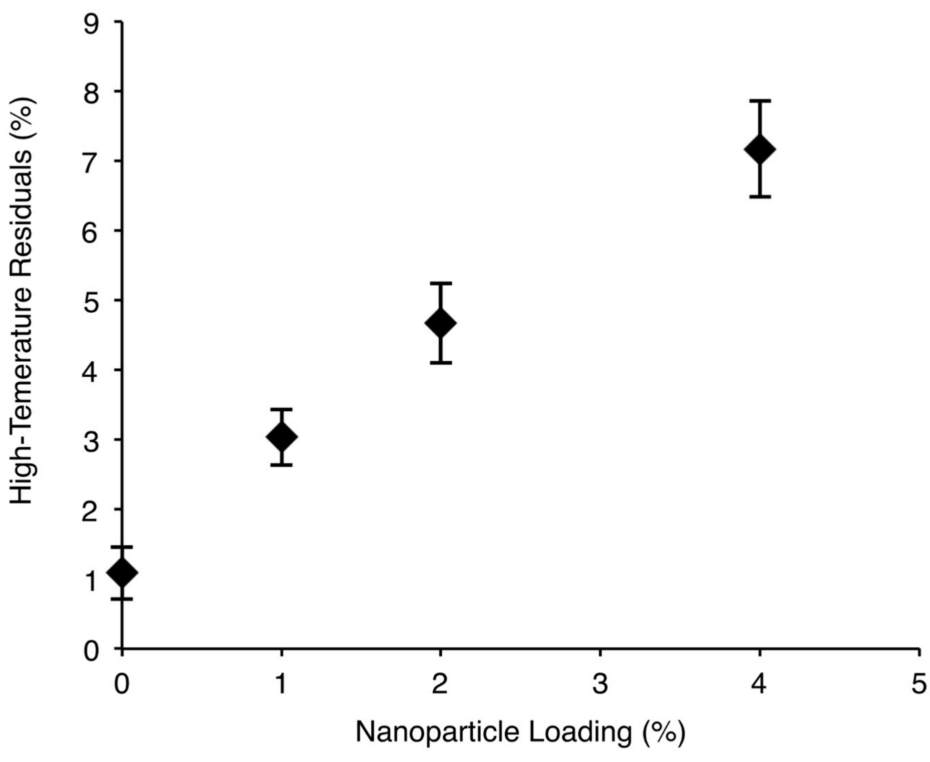


Figure 35: Percentage of total mass remaining after TGA and DTG tests. Error bars indicate sample standard deviation.

### *5.3.4 Cone Calorimetry Studies*

The heat release rate (HRR) for neat PMMA, traditional 1 wt-% silica in PMMA nanocomposites, and 1 wt-% silica cross-linked to PMMA nanocomposites are shown in Figure 36. The results show that even for the low concentration of 1 wt-% silica cross-linked to PMMA, there is a reduction of 18% in the peak heat release rate (pHRR) compared to neat PMMA, and an improvement of 13% compared to a 1 wt-% silica in linear PMMA nanocomposite. There was a small reduction in the total heat released (THR) (7%) compared to neat PMMA, but this was similar for both cross-linked and linear nanocomposites. The decrease in pHRR is attributed to both enhanced char formation and enhanced thermal stability. While greater reductions in pHRR have been achieved, they generally require large amounts of additives[6]. In this case, the presence of covalently bonded nanofillers suggests benefits over traditional surface treated nanoparticles.

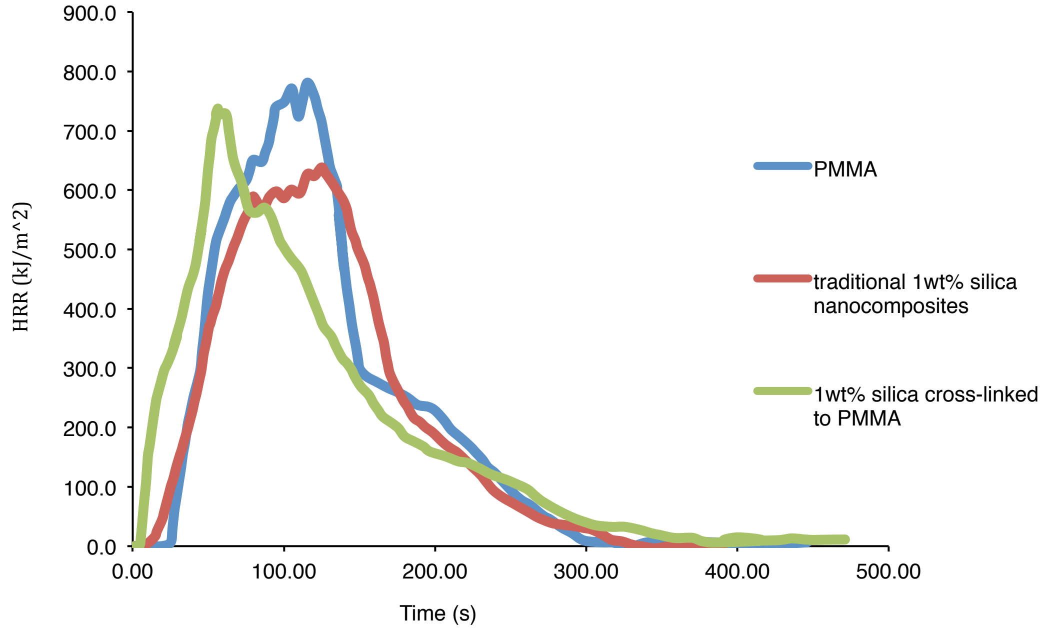


Figure 36: HRR results. Results for neat PMMA, 1 wt-% silica in PMMA nanocomposites, and 1 wt-% silica cross-linked to PMMA nanocomposites.

### 5.4 Conclusions

Nanosilica surface treated with KH570 was used to covalently cross-link poly(methyl methacrylate) (PMMA), producing nanocomposites with silica-based cross-linkages. The materials were synthesized using an *in-situ* method with nanosilica loadings of 0 wt-%, 1 wt-%, 2 wt-%, and 4 wt-% in PMMA. Morphological studies using Scanning Electron Microscopy (SEM) and X-Ray Diffraction (XRD) showed nanosilica, with a diameter of 20-30nm, was well dispersed into PMMA. Thermogravimetric Analysis (TGA) was used to better understand the thermal degradation of the nanocomposites, showing a stabilizing effect on degradation reactions, leading to a reduction in the peak mass loss rate by 30%. Furthermore, kinetic studies showed that the thermal degradation of PMMA and all nanocomposites could be described by a single first-order pseudo-step reaction. Model-free kinetic analyses were also conducted and showed an enhancement of nearly 100 kJ mol$^{-1}$ to the degradation activation energy when compared to PMMA. Even compared to traditional silica-PMMA nanocomposites in literature, the nanocomposites in this work showed roughly 50 kJ mol$^{-1}$ greater enhancement, indicating an improvement over traditional nanofillers. In addition, the nanocomposites showed increased residual yields when compared to both pure PMMA and other traditional silica nanocomposites. Cone Calorimetry studies revealed that even at a low loading of 1 wt-% silica cross-linked to PMMA, there was a 18% reduction in the peak heat release rate (pHRR), with a 13% reduction compared to traditional 1 wt-% silica nanocomposites.

# 6. TMPTA CROSS-LINKED PMMA NANOCOMPOSITES

## 6.1 Introduction

From 1977 to 2014, the total number of fire-related incidents in the United States dropped from 3,264,500 to 1,298,000, indicating significant progress in the ongoing effort to reduce fire losses[50]. Despite this decreasing trend, the total cost due to fire damage in the US was estimated to be $329 billion in 2011, suggesting that there is still significant room for improvement[51]. The development and implementation of flame-retardants for combustible and flammable materials is one step in minimizing total fire losses.

One active area in flame-retardant research is in polymeric materials. The lightweight, low cost, and high performance properties of polymers make them an ideal candidate for many industrial and household products. However, since polymers are generally composed of energy-dense hydrocarbons, their widespread application has the potential to increase the risk of fire if left unmitigated. It is important to address the flammability of polymeric materials through flame-retardants.

Many polymeric flame-retardants increase the final char yield of burned polymers[52]. During a fire, the burning polymer produces char that accumulates as a layer on the surface of the material. This layer serves as a barrier between the unburned polymer and the fire, reducing heat transfer. Furthermore, the presence of char also indicates incomplete combustion. In a fire, the polymer first undergoes pyrolysis, breaking down into smaller, more volatile compounds that diffuse away from the polymer surface and burn in the vapor phase. By enhancing char yield, more mass is retained in the condensed phase where it cannot burn, reducing the total heat released in the fire. Not only can these flame-retardant polymers be used to produce inherently safer bulk plastics, they can also be applied as protective coatings, producing a sacrificial barrier in the event of a fire.

While polymeric flame-retardants have reduced the consequences associated with polymer flammability, many of these flame-retardants have received criticism over their toxicity and environmental impact. One common flame-retardant, tris (1,3-dichloroisopropyl) phosphate (TDCPP) is a known neurotoxin and mutagen in animals, while others flame-retardants, such as a group of flame-retardants called pentaBDE's, are environmentally persistent pollutants[9-12]. To make matters more complicated, the efficacy of flame-retardants in the United States and Europe have prompted the creation of country-specific standards which require the implementation of flame-retardant materials in synthetic furniture, fabrics, and other products[53]. These regulations have lead to an increase in the use of toxic and environmentally persistent flame-retardants, highlighting the need for nontoxic flame-retardant alternatives[54, 55].

In the last three decades, polymeric nanocomposites, generally consisting of inorganic nanoparticles embedded in a polymer matrix, have gained significant attention in literature as potential replacements for antiquated toxic flame-retardants. When burned, flame-retardant nanocomposites produce a physical barrier on the surface of the burning material, similar to charring flame-retardants. However, this physical barrier is composed of carbonaceous char and agglomerated nanoparticles, which act as an insulating layer to reduce heat transfer to the unburned material below[13-19]. In addition, unlike conventional flame-retardants, nanocomposites are generally more thermally stable when compared to neat polymers due to reduced polymer mobility, free-radial trapping by the nanofiller, and the replacement of combustible polymer with thermally stable nanofiller[13]. Since the composition of nanocomposites can be fine tuned with different fillers and polymers, nanocomposites are a good candidate to replace antiquated toxic flame-retardants.

Previous research has been conducted utilizing polymeric nanocomposites in conjunction with traditional flame-retardants with some success. Common flame-retardants such as ammonium polyphosphate (APP) were combined with nanoparticles in a polymeric matrix to produce synergistic flame-retardant systems with enhanced char yields and increased thermal stability[38, 39, 42]. Similar to APP and other flame-retardants, cross-linking has been previously shown to increase the char-yield of polymers, but the thermal stability effects of common cross-linking agents in conjunction with nanofillers have not been adequately studied[44].

In this work, the thermal stability and char yield of cross-linked polymer nanocomposites is studied using poly (methyl methacrylate) (PMMA) cross-linked with trimethylopropane triacrylate (TMPTA). Three different nanofillers, montmorillonite (MMT), aluminum oxide (AO), and nanosilica, are used to observe the effect nanofiller composition has on thermal stability and char yield of TMPTA cross-linked PMMA. In addition, linear (not cross-linked) nanocomposites were produced to compare with the cross-linked materials.

## 6.2 Experimental Methods

### *6.2.1 Materials*

The monomer, methyl methacylate (MMA), and the initiator, 1,1'-azobis(cyclohexanecarbonitrile) (ABCN), is supplied by Polysciences. The nanofillers, which include montmorillonite nanoclay sheets organically modified with aminopropyltriethoxysilane (MMT, nanoscale thickness, <20 micron width), spherical aluminum oxide nanoparticles (AO, 13nm primary particle size), and spherical nanosilica (10-20nm primary particle size), are purchased from Sigma-Aldrich. The cross-linking agent, trimethylolpropane triacrylate (TMPTA) is also supplied by Sigma-Aldrich.

### *6.2.2 Nanocomposite Synthesis*

Nanocomposites are produced using an *in-situ* method. One of the three nanofillers (MMT, AO, or silica) is massed and added to the MMA monomer in a sealed glass vessel so that concentration of nanofiller in the final nanocomposite is 1wt%, 3wt%, or 5wt%. For cross-linked samples, the cross-linking agent, TMPTA, is added to the solution in a 1:60 molar ratio of TMPTA:MMA. No TMPTA is added for linear samples. This solution is mixed using a magnetic stirring bar for 30 minutes, followed by ultrasonication at 20°C for an additional 30 minutes. After ultrasonication, ABCN initiator is massed and added to the solution so that the initiator concentration is equal to 0.5% of the total monomer and cross-linker mass (0.5% of the mass of MMA and TMPTA combined). A magnetic stirring bar is also added to the vessel before it is sealed tightly using a lid with a silicone septum. Two needles are punctured through the silicone septum to begin inerting. One needle bubbles nitrogen through the solution, while the second prevents overpressurization of the glass vessel. The vessel is then transferred to an oil bath which maintains the polymerization temperature at 70°C. A hot plate with a magnetic stirrer is used to continually stir both the glass reaction vessel and the oil bath simultaneously. Polymerization proceeds until approximately five minutes before the solution gels, at which point the partially polymerized solution is transferred to small polypropylene vials. Polyethylene insulation foam is used to keep the small polypropylene vials buoyant as they float in the oil bath for an additional 48 hours to complete curing, after which the materials are removed from their molds and tested.

### *6.2.3 Nanocomposite Characterization*

Thermogravimetric Analysis (TGA) and Derivative Thermogravimetric (DTG) studies were conducted using a Mettler Toledo TGA/DSC 1 under a nitrogen atmosphere and at a ramp rate of 10°C/min. Samples were roughly 5mg in mass and roughly spherical in shape. These data are used to measure the onset of degradation, the char yield, and the general degradation behavior of the nanocomposites produced.

## 6.3 Results and Discussion

Nanocomposites cross-linked by TMPTA with Silica, MMT, and AO nanofillers were tested using TGA and compared with the results from linear nanocomposites to quantify how PMMA cross-linking and nanofiller content interact to affect thermal stability and char yields. In general the low loading (1wt% nanofiller) samples are homogenous, with increasing levels of agglomeration visually apparent at higher loadings. The results for each nanofiller are discussed separately and then compared to understand how differences in nanoparticle structure and chemistry may affect degradation.

### *6.3.1 Silica Nanocomposites*

Figure 37 presents the TGA data for linear 1wt% silica nanocomposites and 1wt% silica nanocomposites cross-linked by TMPTA, while Figure 38 shows the corresponding DTG curves. The TGA data for linear PMMA without nanofiller and PMMA cross-linked by TMPTA without nanofiller are also included in Figure 37. The degradation of linear PMMA and 1wt% silica in linear PMMA occurs in a two-step process, indicated in Figure 37 by two sudden drops in the mass as temperature increases or equivalently in Figure 38 as two mass loss peaks. The first mass loss begins near 200°C, and corresponds to unsaturated-end initiated polymer unzipping, while the second mass loss begins near 300°C, and corresponds to random depolymerization, shown in previous studies[25].

In contrast, cross-linked PMMA and 1wt% silica nanocomposites cross-linked by TMPTA only have one major degradation region, shown in Figure 37 as a single drop in mass as temperature increases and in Figure 38 as a single mass loss peak. The DTG for linear and cross-linked 1wt% silica nanocomposites in Figure 38 clearly shows the low temperature mass loss peak centered at 250°C is absent in the cross-linked nanocomposite. This indicates that the presence of TMPTA cross-linkages stabilize unsaturated-end initiated polymer unzipping, shown in previous studies[44]. In addition, the remaining high temperature mass loss peak centered near 370°C in Figure 38 is shifted upwards in the cross-linked nanocomposite, indicating nanosilica shifts degradations to higher temperatures. This is typical of either a reduction in polymer mobility by nanofiller or a radical trapping mechanism[13].

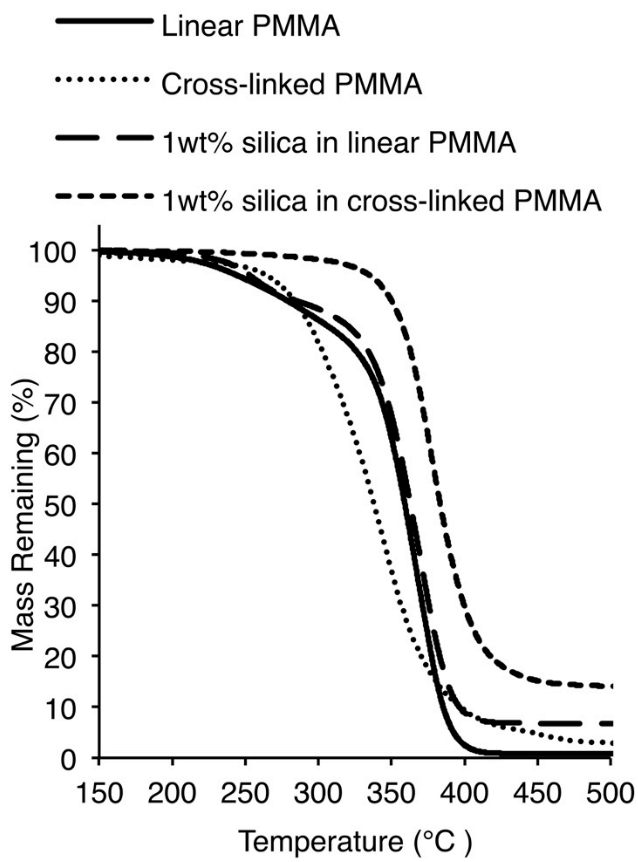


Figure 37: TGA results for 1wt% silica nanocomposites. Measured at a ramp rate of 10°C/min.

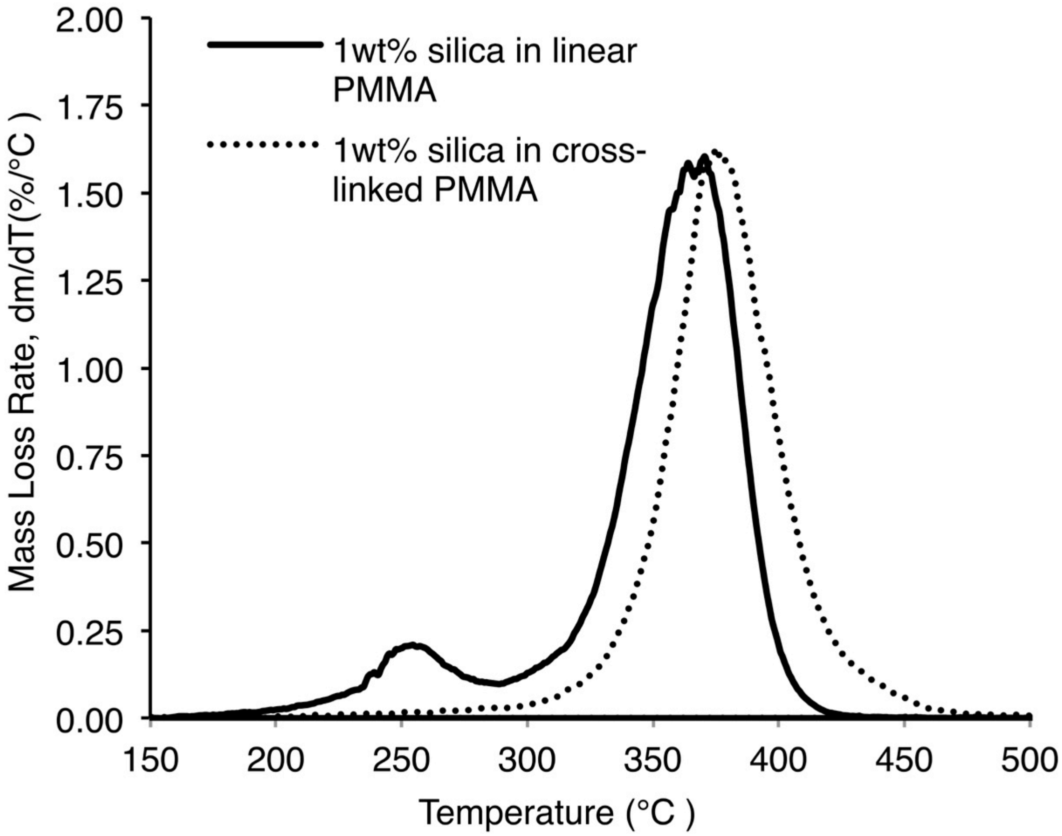


Figure 38: DTG data. Results for 1wt% silica nanocomposites. Measured at a ramp rate of 10°C/min.

Similar behavior is seen from the TGA measurements with 3wt% and 5wt% silica nanocomposites, shown in Figure 39 and Figure 40, respectively. All linear nanocomposites degrade in two mass loss steps, while cross-linked nanocomposites degrade in a single step. In addition, the single mass loss step in cross-linked nanocomposites occurs at elevated temperature when compared to cross-linked PMMA.

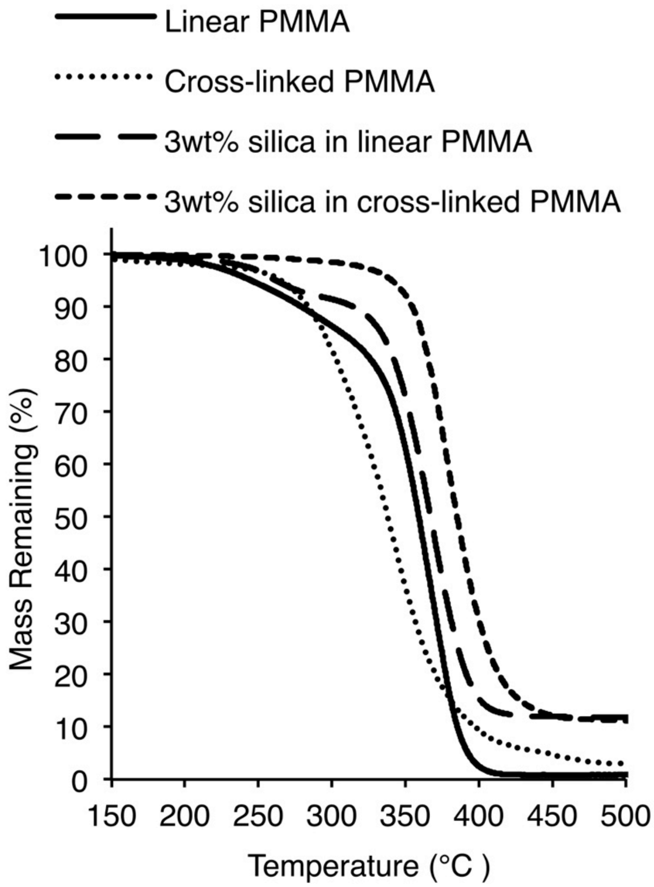


Figure 39: TGA results for 3wt% silica nanocomposites. Measured at a ramp rate of 10°C/min.

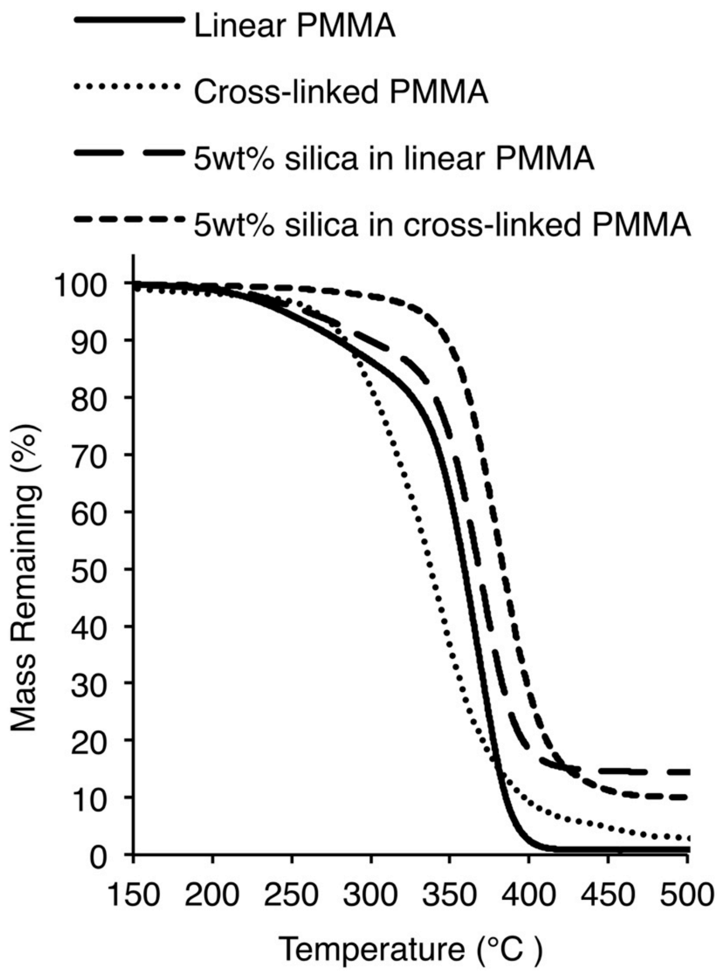


Figure 40: TGA results for 5wt% silica nanocomposite. Measured at a ramp rate of 10°C/min.

The onset of degradation, defined here as the temperature at 5% mass loss, is dramatically improved in all silica nanocomposites. However, silica nanocomposites cross-linked by TMPTA outperformed linear silica nanocomposites without cross-linking drastically. As shown in Figure 37, cross-linked PMMA showed a 20°C increase in the onset of degradation compared to linear PMMA, while a linear 1wt% silica nanocomposite showed a 9°C increase in the onset of degradation. For the cross-linked

1wt% silica nanocomposites, the onset of degradation was increased dramatically by 91°C, significantly more than either silica or cross-linked PMMA separately. The cross-linked 3wt% and 5wt% silica nanocomposites in Figure 39 and 40 show a similar dramatic effect, with a maximum enhancement to the onset of degradation by 96°C.

The increased onset of degradation is explained by two simultaneous effects, which have previously been mentioned in this section. Firstly, polymer cross-linking stabilizes low temperature reactions, leading to one-step degradation. Secondly, the addition of silica delays degradation reactions to higher temperatures because of reduced polymer mobility or free radical trapping. These simultaneous effects provide drastically higher onset degradation temperatures than either silica nanocomposites or cross-linked polymers separately.

The final residuals from TGA at high temperatures, labeled as char, are drastically increased in 1wt% silica nanocomposites cross-linked by TMPTA. Figure 37 shows that the linear PMMA sample produced only a small amount of char, with only 0.8% of the original mass remaining after TGA tests. Cross-linked PMMA had a slight enhancement with 2.8% char yield, while the linear 1wt% silica nanocomposite showed even greater enhancement with 6.8% char yield. However, the use of silica with cross-linked PMMA showed drastic synergistic improvements, producing a char yield of 14.1% for a 1wt% silica nanocomposite cross-linked by TMPTA. This is significantly greater than the char yield of cross-linked PMMA or silica nanocomposites separately. The synergistic interaction on char yield can be explained by reduced internal mass transfer in cross-linked polymers, reported previously[44]. As internal mass transfer is reduced, reactants take longer to diffuse out of the material and into the vapor-space. This allows reactants to spend more time near the surface of nanoparticles, where char-forming reactions occurs[49].

For TGA measurements of 3wt% silica nanocomposites in Figure 39, char yields of linear nanocomposites and TMPTA cross-linked nanocomposites are similar, with 11.8% and 11.2%, respectively. In this case, cross-linking has a neutral effect on silica nanocomposite char yields. At a higher loading of 5wt% silica in PMMA, shown in Figure 40, the char yields of linear nanocomposites and cross-linked nanocomposites changes to 14.4% and 10.0%, respectively, indicating cross-linking has an antagonistic effect on the 5wt% silica nanocomposites tested.

Synergistic enhancements to char yield are lost once silica loading is increased past 1wt%. This is explained through increased agglomeration and phase separation in cross-linked nanocomposites. During *in-situ* polymerization, TMPTA cross-linked materials gel at much lower degree of conversion, reducing the effective amount of mixing during polymerization and increasing the amount of nanoparticle phase separation. With more agglomeration in cross-linked nanocomposites, a smaller fraction of nanoparticle surface is exposed to the polymer, reducing the amount of char forming reactions that occur at the polymer-nanoparticle interface.

### *6.3.2 MMT Nanocomposites*

Nancomposites cross-linked by TMPTA were also produced using organically modified MMT as a nanofiller and compared with linear MMT nanocomposites. The TGA results for nanocomposites with 1wt%, 3wt%, and 5wt% MMT, are shown in Figure 41, 42, and 43, respectively. Similar to the silica nanocomposites in this study, all linear MMT nanocomposites degrade in a two-step fashion, while all TMPTA cross-linked MMT nanocomposites degrade in a single step.

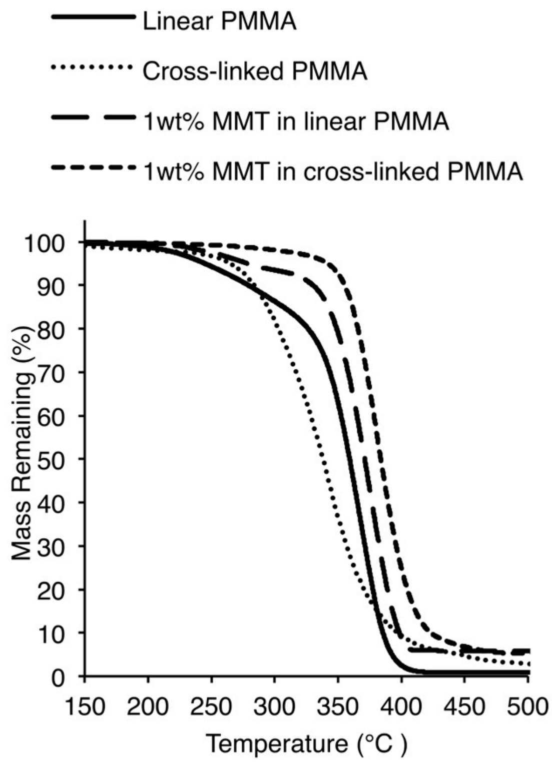


Figure 41: TGA results for linear 1wt% MMT nanocomposites. Measured at a ramp rate of 10°C/min.

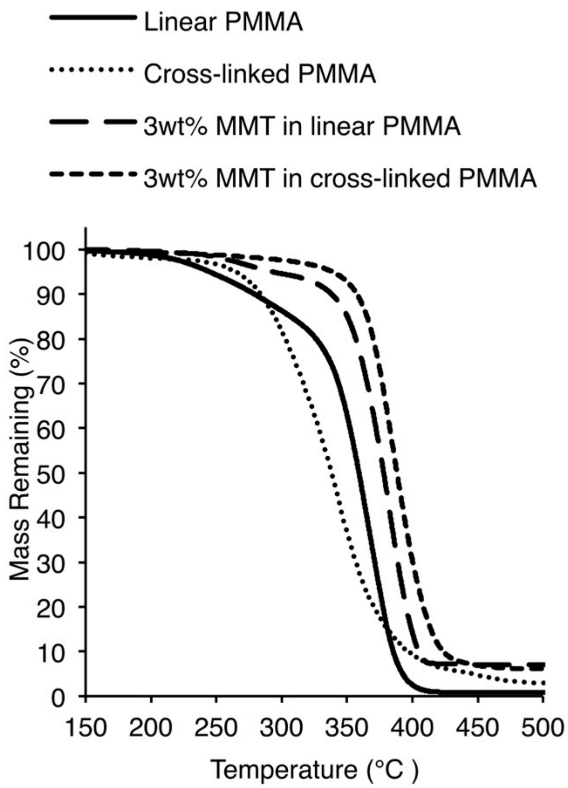


Figure 42: TGA results for linear 3wt% MMT nanocomposites. Measured at a ramp rate of 10°C/min.

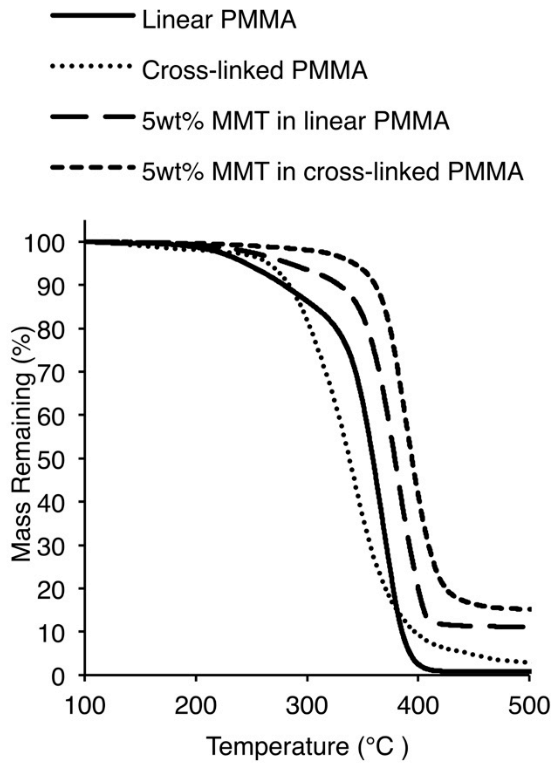


Figure 43: TGA results for linear 5wt% MMT nanocomposites. Measured at a ramp rate of 10°C/min.

The temperature at which the onset of degradation occurs in MMT nanocomposites cross-linked by TMPTA is elevated dramatically, with a maximum increase of 97°C compared to linear PMMA. This is similar to the cross-linked silica nanocomposites previously discussed, and is likely explained by the same two simultaneous complimentary factors.  The single-step degradation caused by cross-linking nearly eliminates low temperature unsaturated-end initiated polymer unzipping, while nanofiller content reduces polymer mobility and traps free radicals, simultaneously increasing the temperature at which the remaining degradation reactions occur.

The char yield of MMT nanocomposites is dependent on TMPTA cross-linkages and MMT loading. For 1wt% MMT nanocomposites in Figure 41, the char yields for linear and cross-linked materials are similar (5.2% and 5.8%, respectively). This indicates TMPTA cross-linking has a neutral effect on char yield for the 1wt% MMT nanocomposites tested. For 3wt% MMT nanocomposites in Figure 42, the char yields of linear nanocomposites and cross-linked nanocomposites are again similar with 7.0% and 6.0%, respectively, indicating a neutral effect. However, for 5wt% MMT nanocomposites in Figure 43, char yields of cross-linked materials are significantly improved, showing 15.2% yield compared to 11.1% with a linear 5wt% MMT nancomposite, indicating a synergistic improvement to char yield.

In contrast to silica nanocomposites previously discussed, increasing the particle loading of TMPTA cross-linked MMT nanocomposites enhanced char yield. This is again explained through a reduction of the internal mass transfer and particle agglomeration. At low loadings, bulky MMT sheets reduce the internal mass transfer of PMMA significantly. Therefore, the introduction of cross-linkages is redundant to the reduction in mass transfer and provides a neutral effect. However, as MMT loading increases, MMT agglomeration and phase separation effectively reduce the number of individual agglomerates present in the material, making MMT less effective at reducing the internal mass transfer of PMMA. In this case, the introduction of cross-linkages further reduces the internal mass transfer in PMMA, resulting in a synergistic improvement to char yields.

### *6.3.3 AO Nanocomposites*

In addition to silica and MMT, AO was embedded in linear PMMA and PMMA cross-linked by TMPTA. The TGA results for 1wt%, 3wt%, and 5wt% AO nanocomposites are shown in Figure 44, 45, and 46, respectively. Linear AO nanocomposite degrade in two steps, while cross-linked AO nanocomposite degrade in a single step, similar to both MMT and silica nanocomposites in this work.

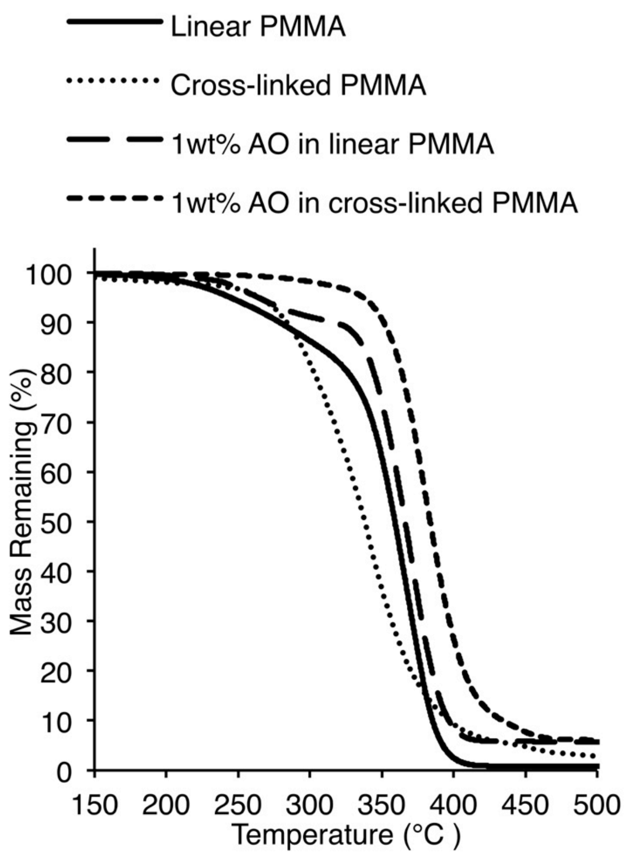


Figure 44: TGA results for linear 1wt% AO nanocomposites. Measured at a ramp rate of 10°C/min.

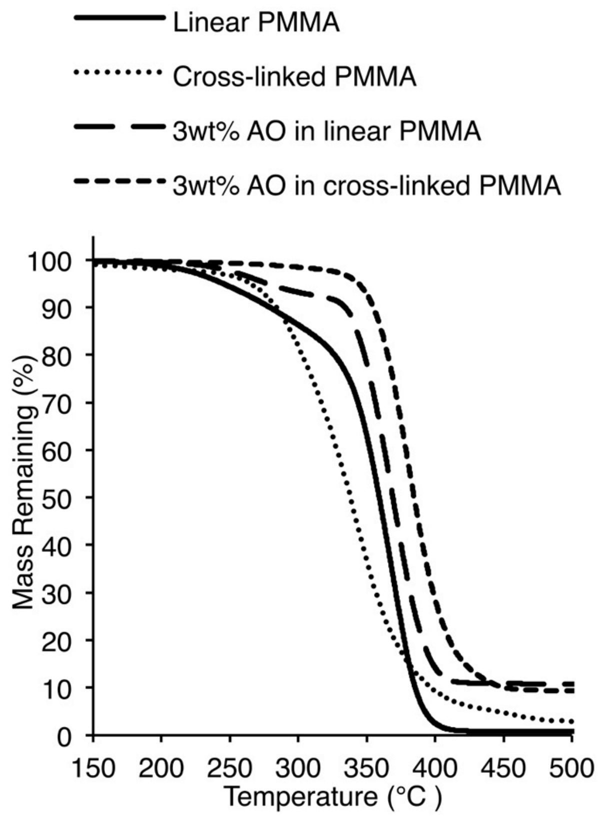


Figure 45: TGA results for linear 3wt% AO nanocomposites. Measured at a ramp rate of 10°C/min.

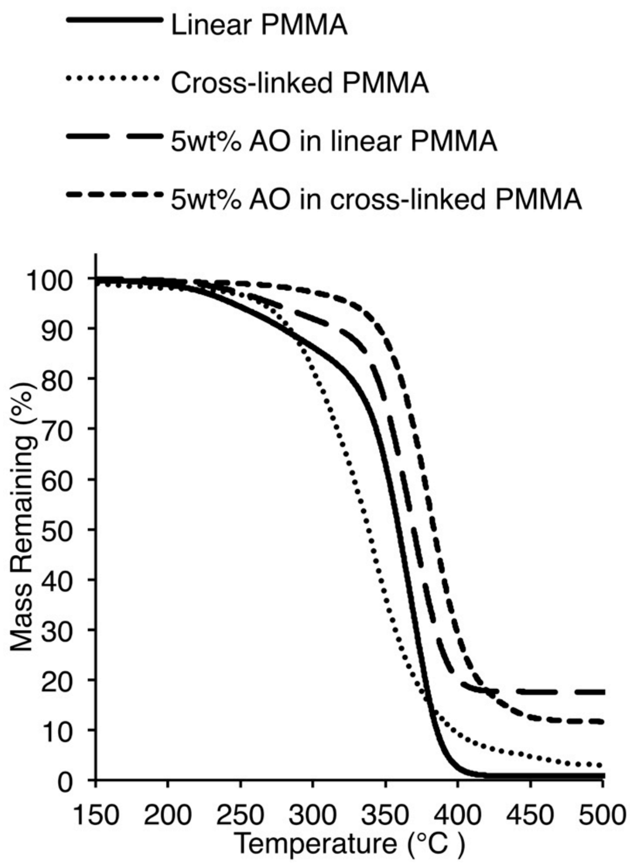


Figure 46: TGA results for linear 5wt% AO nanocomposites. Measured at a ramp rate of 10°C/min.

In addition, cross-linked AO nanocomposites show a significant increase in the temperature of degradation onset, with a maximum increase of 99°C for a cross-linked 3wt% AO nanocomposite. The increase in the onset of degradation is attributed to the same two simultaneous effects as with silica and MMT nanocomposites. Cross-linking eliminates low-temperature degradations, while nanofiller content stabilizes the remaining degradation step, moving it to even higher temperatures.

The char yield of linear and TMPTA cross-linked 1wt% AO nancomposites in Figure 44 are similar (5.7% and 6.1%, respectively), indicating that polymer cross-linking has a neutral effect on char yields in the tested 1wt% AO nanocomposites. The cross-linked nanocomposites in Figure 45 and 46 show less char yield than linear nanocomposites of the same loading, indicating that cross-linking has an antagonistic effect on char yields for the 3wt% and 5wt% AO nanocomposites tested. For AO nanocomposites cross-linked by TMPTA, particle agglomeration is visually more pronounced than in linear AO nanocomposites without cross-linking, causing a significant reduction in nanofiller surface area, and thus char yield.

### *6.3.4 Thermal Degradation Kinetic Studies*

Kinetic studies on linear nanocomposites and nanocomposites cross-linked with trimethylolpropane triacrylate were conducted in order to understand changes in degradation kinetics caused by simultaneous cross-linkages and nanofiller content. The kinetic methods used here are similar to those found in *Section 4: α-Zirconium Phosphate/PMMA Nanocomposites* and *Section 5: PMMA Nanocomposites with Silica Cross-Linkages*. At low loadings, nanofiller content enhances the activation energy of linear PMMA, shown in Figure 47, as well as PMMA cross-linked by trimethylolpropane triacrylate in Figure 48. At high loadings, the activation energy of both linear and cross-linked nanocomposites begins to decrease, likely due to agglomerated nanofiller reducing the overall surface to volume ratio of nanofiller.

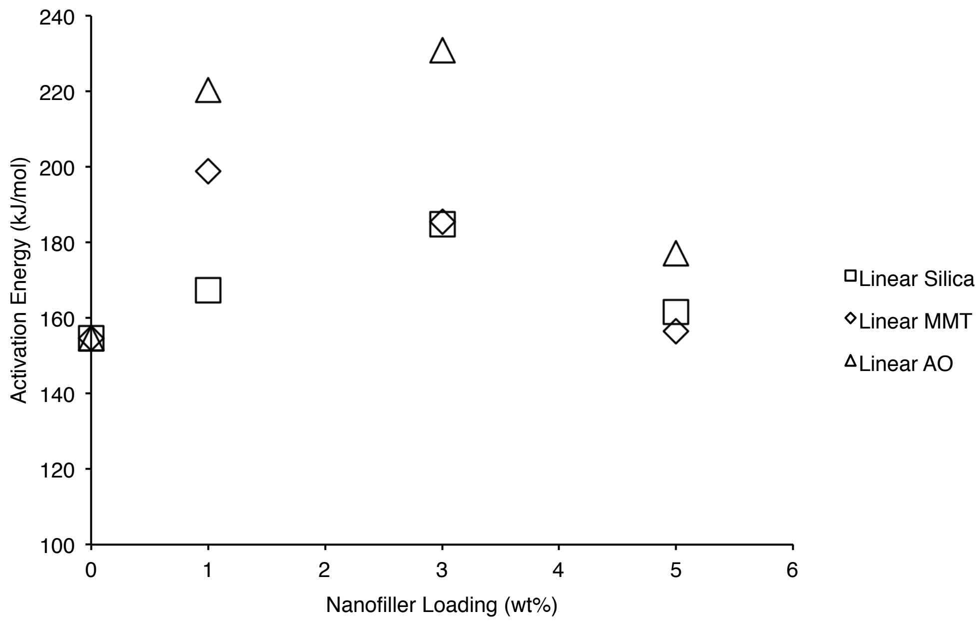


Figure 47: Activation energy for linear nanocomposites.

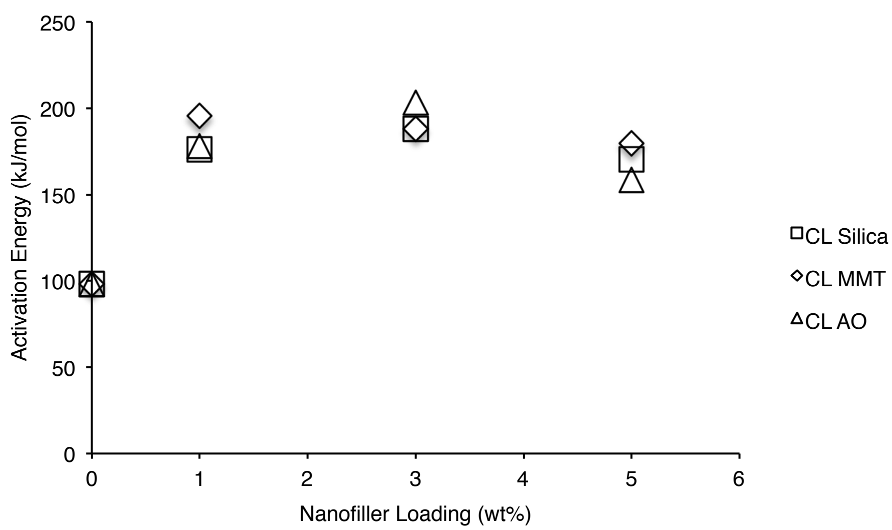


Figure 48: Activation energy for cross-linked nanocomposites.

### *6.3.5 Summary of Thermal Stability and Char Yield Studies*

Nanocomposites cross-linked by TMPTA have significant improvements to thermal stability when compared to linear PMMA, PMMA cross-linked by TMPTA, and linear PMMA nanocomposites without cross-linking, as summarized in Table 2. Firstly, the temperature at degradation onset is drastically increased for all cross-linked nanocomposites observed, with a maximum improvement of 99°C. When compared to cross-linked PMMA and linear nanocomposites, every cross-linked nanocomposite tested had dramatically higher onset of degradation, indicating TMPTA cross-linking has a synergistic effect on the thermal stability of PMMA nanocomposites.

Table 2: Thermal Stability and Char Yield

| Particle | Linear/ Cross-Linked | Particle Loading (wt%) | Temperature at Onset of Degradation (°C) | Char Yield (%) |
|---|---|---|---|---|
| none | linear | 0 | 245 | 0.8 |
| none | cross-linked | 0 | 265 | 2.9 |
| silica | linear | 1 | 253 | 6.7 |
| silica | linear | 3 | 262 | 11.8 |
| silica | linear | 5 | 259 | 14.4 |
| silica | cross-linked | 1 | 335 | 14.1 |
| silica | cross-linked | 3 | 341 | 11.2 |
| silica | cross-linked | 5 | 331 | 10.0 |
| MMT | linear | 1 | 278 | 5.8 |
| MMT | linear | 3 | 293 | 7.0 |
| MMT | linear | 5 | 284 | 11.1 |
| MMT | cross-linked | 1 | 342 | 5.2 |
| MMT | cross-linked | 3 | 339 | 6.1 |
| MMT | cross-linked | 5 | 342 | 15.2 |
| AO | linear | 1 | 264 | 5.7 |
| AO | linear | 3 | 277 | 10.8 |
| AO | linear | 5 | 272 | 17.5 |
| AO | cross-linked | 1 | 337 | 6.1 |
| AO | cross-linked | 3 | 344 | 9.3 |
| AO | cross-linked | 5 | 326 | 11.6 |

As previously discussed, the increase in the onset of degradation is due to the two simultaneous effects. Firstly, TMPTA cross-linkages eliminate the low temperature end initiated unzipping reaction, leaving only one mass loss step. Secondly, the presence of nanofiller reduces polymer mobility and traps free radicals, stabilizing the single remaining degradation step and shifting it towards higher temperatures. The resulting effect appears to be independent of the nanofiller used.

In addition, the behavior of char yield in TMPTA cross-linked nanocomposites is complex. In some cross-linked samples, such as 1wt% silica in cross-linked PMMA, the char yield was significantly higher than with linear 1wt% silica nanocomposites without cross-linking, indicating TMPTA cross-linking had a synergistic effect on the char yield of the nanocomposites. In other cases, cross-linked nanocomposites produced char yields similar to linear nanocomposites, such as 1wt% MMT in cross-linked PMMA. In these cases TMPTA cross-linkages had a neutral effect on char yield in nanocomposites. Finally, some cross-linked nanocomposites had a lower char yield when compared to linear nanocomposites, such as with 5wt% AO in cross-linked PMMA. In these cases, TMPTA cross-linking had an antagonistic effect on char yield in nanocomposites. The synergistic, neutral, and antagonistic effects of polymer cross-linking in PMMA nanocomposites are summarized in Table 3.

The complex char yield behavior is attributed to both agglomeration of nanoparticles and a reduction of internal mass transfer in the nanocomposite. Cross-linking PMMA with TMPTA causes a reduction in internal mass transfer by introducing bulky cross-linkages[44]. The reduction of internal mass transfer effectively increases the amount of time degradation products spend near nanoparticle surfaces where char-forming reactions occur, increasing the char yield. However, since TMPTA cross-linked nanocomposites gel faster than linear nanocomposites, there is less time for mixing during synthesis, resulting in greater amounts of agglomeration and phase separation in TMPTA cross-linked nanocomposites. Therefore, obtaining high char yields in cross-linked nanocomposites relies on a balance between reduced internal mass transfer and increased nanoparticle agglomeration.

Table 3: Effect of TMPTA Cross-Linkages on Nanocomposite Char Yield. Synergistic, Neutral, and Antagonistic Effects

| Nanoparticle | 1wt% Filler | 3wt% Filler | 5wt% Filler |
|---|---|---|---|
| Silica | Synergistic | Neutral | Antagonistic |
| MMT | Neutral | Neutral | Synergistic |
| AO | Neutral | Antagonistic | Antagonistic |

### 6.4 Conclusions

Linear poly (methyl methacrylate) (PMMA) nanocomposites and PMMA nanocomposites cross-linked with TMPTA were synthesized using an *in-situ* bulk polymerization technique and characterized using Thermogravimetric Analysis (TGA) and Derivative Thermogravimetric Analysis (DTG). Both linear and cross-linked PMMA were embedded with silica, organically modified montmorillonite (MMT), and aluminum oxide (AO) nanoparticles separately to quantify the interaction between polymer cross-linking and nanoparticle content. TGA results showed that TMPTA cross-linked nanocomposites show drastic improvements in thermal stability when compared to linear nanocomposites. These effects showed that cross-linking and nanoparticle content work together to synergistically increase on-set of degradation by nearly 100°C. Kinetic studies showed that nanofiller increases the activation energy for the degradation reactions in both linear and cross-linked PMMA, indicating nanofillers stabilize both linear and cross-linked PMMA. In addition, nanocomposites cross-linked by TMPTA were shown to dramatically increase char yield when compared to linear nanocomposites without cross-linkages. Cross-linked PMMA with 1wt% silica produced 14.1% char, similar to linear PMMA with 5wt% MMT, silica, or AO. In this case, utilizing the common cross-linking agent TMPTA in conjunction with nanofiller increases the char yield of PMMA drastically, while only using one-fifth of the expensive nanoparticle component.

# 7. SUMMARY AND CONCLUSIONS

## 7.1 Summary

The work in this dissertation can be separated into two categories. First, new nanofillers were embedded into polymer matrices, producing novel high-loading polymeric nanocomposites with enhanced thermal stability and UV scattering/absorbing capabilities. Second, existing polymeric nanocomposites were improved through polymeric cross-linkages, producing flame-retardant nanocomposites with dramatically enhanced thermal stability and char yield when compared to traditional nanocomposites without cross-linking. Specific accomplishments are as follows:

1) A nanometer-thick, 40nm wide nanoplate, ZrP was embedded into PMMA using a solution casting method. The ZrP synthesis route produces low polydispersity ZrP nanoplates intercalated with alcohol, making them easy to disperse in solution casting techniques. This allowed nanocomposites with up to 30wt% ZrP to be synthesized.
2) Nanocomposites consisting of ZrP in PMMA were characterized using XRD to show they are well dispersed. Further characterization by UV-vis showed ZrP/PMMA nanocomposites have dramatic UV scattering and absorbing capabilities while remaining highly transparent through the visible spectrum.

TGA tests showed ZrP enhanced the activation energy for polymer degradation, producing more thermally stable materials than PMMA alone.

3) In the initial steps to quantify the effects of polymer cross-linking on nanocomposite degradation, 20-30nm diameter silica surface treated with KH570, an organic surface treatment capable of polymerization, was used to cross-link PMMA using an *in-situ* polymerization method. This produced nanocomposites that are covalently cross-linked by nanofiller. Synthesis of these materials was done using silica loadings between 1 and 4wt% silica in PMMA. Another organic silica surface treatment, KH550, which does not under polymerization was used in comparison with the cross-linked materials.
4) Material characterization using XRD showed the silica nanocomposites were well dispersed and homogeneous. TGA results showed that silica cross-linkages increase the degradation activation energy significantly more than traditional silica which is not covalently bonded to PMMA. The silica cross-linked PMMA nanocomposites also possess higher char yields than traditional silica nanocomposites, improving existing flame-retardants. Lastly, cone calorimetry studies showed that silica cross-linked nanocomposites decreased the peak heat release rate more than traditional silica nanocomposites at low silica loadings.
5) To better understand how polymer cross-linking affects nanocomposite degradation, a separate cross-linking agent, trimethylolpropane triacrylate was utilized. Three common nanofillers, MMT, AO, and silica were embedded into linear PMMA and PMMA cross-linked by trimethylolpropane triacrylate,

producing cross-linked and linear nanocomposites. This was repeated for loadings of 1, 3, and 5wt% nanofiller.

6) Cross-linked nanocomposites showed dramatic synergistic improvements to thermal stability. The temperature at which the on-set of thermal degradation occurs was increased by nearly 100°C. This is significantly more than either nanofiller or cross-linking alone.
7) Polymer cross-linkages have the potential to synergistically enhance char yield of nanocomposites. In one case, a 1wt% silica nanocomposite in cross-linked PMMA provided the same char yield as a 5wt% silica nanocomposite without cross-linkages.
8) Utilizing polymer cross-linkages in conjunction with nanofiller content provides synergistic enhancement to thermal stability and char yields. This makes cross-linked nanocomposites more resistant to heat and more effective as flame-retardants when compared to traditional linear nanocomposites.

### 7.2 Future Work

This work focused mainly on the effects on chemical thermal stability for polymeric nanocomposites. However, nanofillers can alter mechanical properties significantly, so studies on these aspects of cross-linked nanocomposites and ZrP nanocomposites would give valuable insight. Mechanical studies could include tensile and compression testing, along with viscoelastic mechanical testing. Hardness tests and scratch resistance are also important points of interest and would give insight in how these materials will handle abrasion and wear.

Previously in literature, phosphorous-based flame-retardants were used effectively in conjunction with polymeric nanocomposites, resulting in reinforced chars. These structurally stronger char residues were attributed in part to a reaction between nanofiller and phosphorous-based compounds. Since the work in this dissertation has shown synergism between nanofiller and polymeric cross-linkages, tertiary systems that include polymer cross-linkages, nanofillers, and a phosphorous-based flame-retardant, such as the intumescent ammonium polyphosphate, should be investigated. These tertiary systems have the potential to create more effective intumescent flame-retardant polymers.

The enhancement to the char yield of cross-linked polymeric nanocomposites in this dissertation was hypothesized to be in part due to reduced internal mass transport, which allowed more residence time for degradation products to react with catalytic nanofillers. Studies to observe changes in mass transport within cross-linked nanocomposites would be required to confirm this proposed hypothesis.

Finally, the chemistry of char-forming reaction on the surface of the nanofiller is not fully understood for the cross-linked polymer nanocomopsites in this work. In-depth studies on the chemistry of these char-forming reactions and the effect of chemical structure and morphology of the nanofiller on these reactions are essential to understand the flame-retardancy of cross-linked nanocomposites.

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# APPENDIX A

# DATA USED IN SECTION 4

Table A-1: TGA and DTG for PMMA, 5wt%, and 10wt% ZrP in PMMA

| Pure PMMA, 10 C/min | | | 5wt% ZrP in PMMA, 10 C/min | | | 10wt% ZrP in PMMA, 10 C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 250 | 100.000 | 0.035500 | 250 | 100.000 | 0.021887 | 251 | 100.000 | 0.023285 |
| 251 | 99.967 | 0.034560 | 251 | 99.978 | 0.022538 | 252 | 99.978 | 0.024040 |
| 252 | 99.934 | 0.033479 | 252 | 99.957 | 0.023353 | 253 | 99.957 | 0.024644 |
| 253 | 99.902 | 0.032365 | 253 | 99.935 | 0.024275 | 254 | 99.925 | 0.025431 |
| 254 | 99.869 | 0.031141 | 254 | 99.902 | 0.025318 | 255 | 99.903 | 0.026327 |
| 255 | 99.836 | 0.030137 | 255 | 99.881 | 0.026436 | 256 | 99.881 | 0.027189 |
| 256 | 99.803 | 0.029274 | 256 | 99.859 | 0.027608 | 257 | 99.838 | 0.028085 |
| 257 | 99.782 | 0.028443 | 257 | 99.826 | 0.029497 | 258 | 99.817 | 0.029034 |
| 258 | 99.749 | 0.027886 | 258 | 99.794 | 0.031234 | 259 | 99.795 | 0.029983 |
| 259 | 99.727 | 0.027318 | 259 | 99.761 | 0.032266 | 260 | 99.763 | 0.031148 |
| 260 | 99.705 | 0.027089 | 260 | 99.739 | 0.033547 | 261 | 99.730 | 0.032129 |
| 261 | 99.672 | 0.027111 | 261 | 99.696 | 0.034752 | 262 | 99.698 | 0.033305 |
| 262 | 99.650 | 0.027351 | 262 | 99.653 | 0.036066 | 263 | 99.666 | 0.034502 |
| 263 | 99.618 | 0.027712 | 263 | 99.631 | 0.037347 | 264 | 99.633 | 0.035904 |
| 264 | 99.596 | 0.028269 | 264 | 99.587 | 0.038704 | 265 | 99.590 | 0.037522 |
| 265 | 99.563 | 0.029055 | 265 | 99.544 | 0.040300 | 266 | 99.558 | 0.039312 |
| 266 | 99.530 | 0.030027 | 266 | 99.511 | 0.041917 | 267 | 99.515 | 0.041307 |
| 267 | 99.508 | 0.031229 | 267 | 99.468 | 0.044414 | 268 | 99.472 | 0.043378 |
| 268 | 99.476 | 0.032660 | 268 | 99.425 | 0.046987 | 269 | 99.428 | 0.045546 |
| 269 | 99.443 | 0.034287 | 269 | 99.370 | 0.048920 | 270 | 99.385 | 0.047918 |
| 270 | 99.410 | 0.036242 | 270 | 99.316 | 0.051156 | 271 | 99.331 | 0.050539 |
| 271 | 99.366 | 0.038460 | 271 | 99.273 | 0.053632 | 272 | 99.277 | 0.053225 |
| 272 | 99.334 | 0.040950 | 272 | 99.207 | 0.056357 | 273 | 99.223 | 0.056040 |
| 273 | 99.290 | 0.043768 | 273 | 99.164 | 0.059223 | 274 | 99.170 | 0.058984 |
| 274 | 99.246 | 0.046871 | 274 | 99.099 | 0.062339 | 275 | 99.116 | 0.062176 |
| 275 | 99.203 | 0.050311 | 275 | 99.034 | 0.065671 | 276 | 99.051 | 0.065574 |
| 276 | 99.148 | 0.054058 | 276 | 98.969 | 0.069319 | 277 | 98.975 | 0.069198 |
| 277 | 99.093 | 0.058045 | 277 | 98.893 | 0.073401 | 278 | 98.911 | 0.072940 |
| 278 | 99.028 | 0.062359 | 278 | 98.817 | 0.077668 | 279 | 98.835 | 0.076812 |
| 279 | 98.973 | 0.067023 | 279 | 98.741 | 0.081945 | 280 | 98.760 | 0.080943 |
| 280 | 98.897 | 0.072048 | 280 | 98.665 | 0.086429 | 281 | 98.673 | 0.085375 |
| 281 | 98.820 | 0.077324 | 281 | 98.567 | 0.091271 | 282 | 98.587 | 0.090099 |
| 282 | 98.744 | 0.082960 | 282 | 98.480 | 0.096406 | 283 | 98.490 | 0.094888 |
| 283 | 98.656 | 0.088706 | 283 | 98.382 | 0.101596 | 284 | 98.404 | 0.100032 |
| 284 | 98.569 | 0.094528 | 284 | 98.274 | 0.106688 | 285 | 98.296 | 0.105479 |
| 285 | 98.471 | 0.100481 | 285 | 98.165 | 0.111823 | 286 | 98.188 | 0.110979 |
| 286 | 98.372 | 0.107144 | 286 | 98.046 | 0.117143 | 287 | 98.080 | 0.116480 |
| 287 | 98.263 | 0.113490 | 287 | 97.926 | 0.122897 | 288 | 97.962 | 0.122304 |
| 288 | 98.143 | 0.119607 | 288 | 97.807 | 0.129193 | 289 | 97.832 | 0.128236 |
| 289 | 98.023 | 0.126051 | 289 | 97.677 | 0.135490 | 290 | 97.692 | 0.134167 |
| 290 | 97.892 | 0.132933 | 290 | 97.546 | 0.141896 | 291 | 97.563 | 0.140531 |
| 291 | 97.750 | 0.140470 | 291 | 97.394 | 0.148735 | 292 | 97.422 | 0.147002 |
| 292 | 97.608 | 0.148553 | 292 | 97.242 | 0.155901 | 293 | 97.271 | 0.153365 |
| 293 | 97.466 | 0.158165 | 293 | 97.080 | 0.162849 | 294 | 97.110 | 0.159944 |
| 294 | 97.302 | 0.168651 | 294 | 96.917 | 0.169146 | 295 | 96.948 | 0.167062 |
| 295 | 97.127 | 0.179902 | 295 | 96.743 | 0.175225 | 296 | 96.775 | 0.174396 |
| 296 | 96.952 | 0.191699 | 296 | 96.558 | 0.181739 | 297 | 96.603 | 0.181406 |
| 297 | 96.756 | 0.203823 | 297 | 96.374 | 0.188796 | 298 | 96.419 | 0.188848 |
| 298 | 96.526 | 0.215729 | 298 | 96.189 | 0.196721 | 299 | 96.225 | 0.196506 |
| 299 | 96.308 | 0.227198 | 299 | 95.994 | 0.205407 | 300 | 96.031 | 0.204379 |
| 300 | 96.079 | 0.238558 | 300 | 95.788 | 0.214092 | 301 | 95.815 | 0.212683 |
| 301 | 95.838 | 0.250464 | 301 | 95.571 | 0.223103 | 302 | 95.600 | 0.221096 |
| 302 | 95.587 | 0.262370 | 302 | 95.343 | 0.232222 | 303 | 95.384 | 0.230047 |
| 303 | 95.314 | 0.276352 | 303 | 95.093 | 0.241125 | 304 | 95.147 | 0.239107 |
| 304 | 95.041 | 0.290661 | 304 | 94.843 | 0.250136 | 305 | 94.899 | 0.248382 |
| 305 | 94.746 | 0.305953 | 305 | 94.593 | 0.259038 | 306 | 94.651 | 0.258089 |
| 306 | 94.429 | 0.319388 | 306 | 94.333 | 0.268049 | 307 | 94.392 | 0.268119 |

Table A-1: Continued

| Pure PMMA, 10 C/min | | | 5wt% ZrP in PMMA, 10 C/min | | | 10wt% ZrP in PMMA, 10 C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 307 | 94.102 | 0.332387 | 307 | 94.072 | 0.276951 | 308 | 94.111 | 0.278149 |
| 308 | 93.741 | 0.345931 | 308 | 93.779 | 0.285745 | 309 | 93.831 | 0.288611 |
| 309 | 93.381 | 0.361988 | 309 | 93.486 | 0.296059 | 310 | 93.540 | 0.299180 |
| 310 | 93.042 | 0.378482 | 310 | 93.193 | 0.307133 | 311 | 93.238 | 0.310397 |
| 311 | 92.682 | 0.398252 | 311 | 92.878 | 0.318424 | 312 | 92.925 | 0.321937 |
| 312 | 92.277 | 0.416821 | 312 | 92.574 | 0.329823 | 313 | 92.591 | 0.333585 |
| 313 | 91.851 | 0.437138 | 313 | 92.238 | 0.341548 | 314 | 92.256 | 0.345233 |
| 314 | 91.371 | 0.459858 | 314 | 91.868 | 0.353816 | 315 | 91.900 | 0.356881 |
| 315 | 90.901 | 0.483015 | 315 | 91.521 | 0.366301 | 316 | 91.534 | 0.368637 |
| 316 | 90.399 | 0.508138 | 316 | 91.141 | 0.379220 | 317 | 91.167 | 0.380285 |
| 317 | 89.918 | 0.535664 | 317 | 90.761 | 0.391271 | 318 | 90.779 | 0.391501 |
| 318 | 89.361 | 0.562534 | 318 | 90.359 | 0.402562 | 319 | 90.380 | 0.402718 |
| 319 | 88.815 | 0.589623 | 319 | 89.958 | 0.414179 | 320 | 89.970 | 0.413719 |
| 320 | 88.225 | 0.618023 | 320 | 89.523 | 0.426555 | 321 | 89.549 | 0.424612 |
| 321 | 87.559 | 0.648280 | 321 | 89.100 | 0.438497 | 322 | 89.118 | 0.435505 |
| 322 | 86.849 | 0.680612 | 322 | 88.666 | 0.450983 | 323 | 88.686 | 0.446074 |
| 323 | 86.171 | 0.709558 | 323 | 88.199 | 0.464553 | 324 | 88.233 | 0.456536 |
| 324 | 85.505 | 0.737957 | 324 | 87.732 | 0.478015 | 325 | 87.770 | 0.467105 |
| 325 | 84.730 | 0.767122 | 325 | 87.244 | 0.491912 | 326 | 87.295 | 0.477783 |
| 326 | 83.965 | 0.806991 | 326 | 86.755 | 0.506677 | 327 | 86.810 | 0.488568 |
| 327 | 83.069 | 0.844894 | 327 | 86.234 | 0.520682 | 328 | 86.314 | 0.499353 |
| 328 | 82.283 | 0.883233 | 328 | 85.702 | 0.534578 | 329 | 85.818 | 0.510354 |
| 329 | 81.453 | 0.916767 | 329 | 85.170 | 0.548909 | 330 | 85.300 | 0.521462 |
| 330 | 80.448 | 0.946259 | 330 | 84.605 | 0.564217 | 331 | 84.771 | 0.532679 |
| 331 | 79.356 | 0.980011 | 331 | 84.030 | 0.580502 | 332 | 84.232 | 0.544327 |
| 332 | 78.416 | 1.016821 | 332 | 83.455 | 0.597546 | 333 | 83.682 | 0.556299 |
| 333 | 77.433 | 1.056363 | 333 | 82.857 | 0.616328 | 334 | 83.121 | 0.568809 |
| 334 | 76.395 | 1.090005 | 334 | 82.239 | 0.636087 | 335 | 82.550 | 0.581859 |
| 335 | 75.347 | 1.123976 | 335 | 81.576 | 0.657475 | 336 | 81.967 | 0.595772 |
| 336 | 74.178 | 1.170945 | 336 | 80.914 | 0.680599 | 337 | 81.363 | 0.610548 |
| 337 | 72.889 | 1.215729 | 337 | 80.230 | 0.705569 | 338 | 80.748 | 0.626079 |
| 338 | 71.655 | 1.258329 | 338 | 79.524 | 0.730757 | 339 | 80.112 | 0.642688 |
| 339 | 70.421 | 1.299836 | 339 | 78.775 | 0.758224 | 340 | 79.465 | 0.660160 |
| 340 | 69.099 | 1.335882 | 340 | 78.015 | 0.787754 | 341 | 78.796 | 0.679034 |
| 341 | 67.701 | 1.373020 | 341 | 77.212 | 0.820215 | 342 | 78.117 | 0.698878 |
| 342 | 66.357 | 1.403605 | 342 | 76.387 | 0.854088 | 343 | 77.416 | 0.720341 |
| 343 | 64.861 | 1.433097 | 343 | 75.518 | 0.891543 | 344 | 76.682 | 0.742882 |
| 344 | 63.419 | 1.461496 | 344 | 74.596 | 0.930735 | 345 | 75.928 | 0.767041 |
| 345 | 61.868 | 1.486619 | 345 | 73.662 | 0.972424 | 346 | 75.151 | 0.792386 |
| 346 | 60.448 | 1.517204 | 346 | 72.674 | 1.016502 | 347 | 74.353 | 0.818378 |
| 347 | 59.006 | 1.542327 | 347 | 71.643 | 1.062208 | 348 | 73.522 | 0.846635 |
| 348 | 57.357 | 1.567449 | 348 | 70.568 | 1.108457 | 349 | 72.670 | 0.875324 |
| 349 | 55.773 | 1.591480 | 349 | 69.428 | 1.155141 | 350 | 71.775 | 0.905630 |
| 350 | 54.189 | 1.614418 | 350 | 68.244 | 1.199653 | 351 | 70.858 | 0.937123 |
| 351 | 52.485 | 1.640634 | 351 | 67.018 | 1.243079 | 352 | 69.909 | 0.970233 |
| 352 | 50.890 | 1.658110 | 352 | 65.737 | 1.283248 | 353 | 68.928 | 1.003236 |
| 353 | 49.252 | 1.666849 | 353 | 64.434 | 1.317989 | 354 | 67.903 | 1.037964 |
| 354 | 47.581 | 1.672310 | 354 | 63.088 | 1.350559 | 355 | 66.846 | 1.072692 |
| 355 | 45.844 | 1.679956 | 355 | 61.709 | 1.377701 | 356 | 65.757 | 1.107636 |
| 356 | 44.129 | 1.683233 | 356 | 60.308 | 1.402671 | 357 | 64.635 | 1.143227 |
| 357 | 42.523 | 1.682141 | 357 | 58.897 | 1.424384 | 358 | 63.471 | 1.179896 |
| 358 | 40.786 | 1.679956 | 358 | 57.453 | 1.442840 | 359 | 62.284 | 1.215487 |
| 359 | 39.115 | 1.676679 | 359 | 55.998 | 1.460211 | 360 | 61.044 | 1.251079 |
| 360 | 37.368 | 1.673403 | 360 | 54.522 | 1.475410 | 361 | 59.771 | 1.285591 |
| 361 | 35.740 | 1.672310 | 361 | 53.034 | 1.489523 | 362 | 58.466 | 1.319025 |
| 362 | 34.134 | 1.670126 | 362 | 51.536 | 1.500380 | 363 | 57.118 | 1.350302 |
| 363 | 32.463 | 1.662480 | 363 | 50.027 | 1.510151 | 364 | 55.759 | 1.381579 |
| 364 | 30.748 | 1.648280 | 364 | 48.507 | 1.517751 | 365 | 54.357 | 1.409620 |
| 365 | 29.066 | 1.634080 | 365 | 46.976 | 1.522093 | 366 | 52.923 | 1.435505 |
| 366 | 27.428 | 1.613326 | 366 | 45.446 | 1.525350 | 367 | 51.478 | 1.458154 |
| 367 | 25.789 | 1.581649 | 367 | 43.915 | 1.525350 | 368 | 50.000 | 1.478645 |
| 368 | 24.238 | 1.544511 | 368 | 42.395 | 1.524264 | 369 | 48.490 | 1.496980 |
| 369 | 22.720 | 1.499727 | 369 | 40.864 | 1.519922 | 370 | 46.980 | 1.511001 |
| 370 | 21.223 | 1.453850 | 370 | 39.344 | 1.513408 | 371 | 45.459 | 1.520708 |
| 371 | 19.792 | 1.404697 | 371 | 37.813 | 1.503637 | 372 | 43.928 | 1.527179 |
| 372 | 18.405 | 1.354451 | 372 | 36.315 | 1.491695 | 373 | 42.386 | 1.530414 |
| 373 | 17.105 | 1.298744 | 373 | 34.817 | 1.476495 | 374 | 40.843 | 1.531493 |

Table A-1: Continued

| Pure PMMA, 10 C/min | | | 5wt% ZrP in PMMA, 10 C/min | | | 10wt% ZrP in PMMA, 10 C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 374 | 15.806 | 1.241944 | 374 | 33.351 | 1.458039 | 375 | 39.312 | 1.528257 |
| 375 | 14.582 | 1.185145 | 375 | 31.897 | 1.437412 | 376 | 37.780 | 1.522865 |
| 376 | 13.424 | 1.127253 | 376 | 30.474 | 1.413527 | 377 | 36.249 | 1.516393 |
| 377 | 12.310 | 1.066084 | 377 | 29.063 | 1.388557 | 378 | 34.739 | 1.506687 |
| 378 | 11.273 | 1.005461 | 378 | 27.684 | 1.362501 | 379 | 33.240 | 1.496980 |
| 379 | 10.298 | 0.944293 | 379 | 26.327 | 1.334274 | 380 | 31.752 | 1.484038 |
| 380 | 9.395 | 0.882250 | 380 | 25.003 | 1.303876 | 381 | 30.263 | 1.470017 |
| 381 | 8.552 | 0.817368 | 381 | 23.711 | 1.273477 | 382 | 28.786 | 1.452761 |
| 382 | 7.765 | 0.757400 | 382 | 22.451 | 1.240908 | 383 | 27.330 | 1.433348 |
| 383 | 7.043 | 0.699727 | 383 | 21.225 | 1.208338 | 384 | 25.906 | 1.410699 |
| 384 | 6.377 | 0.644675 | 384 | 20.030 | 1.175768 | 385 | 24.504 | 1.384814 |
| 385 | 5.741 | 0.593119 | 385 | 18.869 | 1.143198 | 386 | 23.113 | 1.352459 |
| 386 | 5.223 | 0.545385 | 386 | 17.761 | 1.111714 | 387 | 21.775 | 1.316868 |
| 387 | 4.693 | 0.499618 | 387 | 16.665 | 1.080339 | 388 | 20.459 | 1.275884 |
| 388 | 4.220 | 0.457236 | 388 | 15.601 | 1.050266 | 389 | 19.187 | 1.228430 |
| 389 | 3.797 | 0.417914 | 389 | 14.559 | 1.020736 | 390 | 17.968 | 1.175582 |
| 390 | 3.405 | 0.381649 | 390 | 13.560 | 0.990663 | 391 | 16.803 | 1.118421 |
| 391 | 3.046 | 0.346259 | 391 | 12.583 | 0.959071 | 392 | 15.703 | 1.054357 |
| 392 | 2.721 | 0.315456 | 392 | 11.627 | 0.923678 | 393 | 14.679 | 0.985009 |
| 393 | 2.426 | 0.286182 | 393 | 10.709 | 0.885463 | 394 | 13.719 | 0.910267 |
| 394 | 2.159 | 0.259093 | 394 | 9.830 | 0.842471 | 395 | 12.834 | 0.827006 |
| 395 | 1.921 | 0.234407 | 395 | 8.995 | 0.793833 | 396 | 12.015 | 0.733822 |
| 396 | 1.703 | 0.211578 | 396 | 8.209 | 0.738031 | 397 | 11.303 | 0.636648 |
| 397 | 1.510 | 0.190060 | 397 | 7.486 | 0.678754 | 398 | 10.688 | 0.533865 |
| 398 | 1.334 | 0.171819 | 398 | 6.827 | 0.612854 | 399 | 10.206 | 0.429142 |
| 399 | 1.174 | 0.155106 | 399 | 6.238 | 0.542178 | 400 | 9.846 | 0.331536 |
| 400 | 1.031 | 0.140142 | 400 | 5.720 | 0.468244 | 401 | 9.608 | 0.245902 |
| 401 | 0.902 | 0.127144 | 401 | 5.282 | 0.393008 | 402 | 9.472 | 0.171484 |
| 402 | 0.785 | 0.114910 | 402 | 4.923 | 0.317338 | 403 | 9.388 | 0.115186 |
| 403 | 0.671 | 0.104020 | 403 | 4.651 | 0.247639 | 404 | 9.343 | 0.075938 |
| 404 | 0.586 | 0.094233 | 404 | 4.472 | 0.183802 | 405 | 9.307 | 0.049871 |
| 405 | 0.494 | 0.085199 | 405 | 4.361 | 0.129193 | 406 | 9.277 | 0.035138 |
| 406 | 0.416 | 0.076734 | 406 | 4.291 | 0.087330 | 407 | 9.255 | 0.027470 |
| 407 | 0.341 | 0.068804 | 407 | 4.258 | 0.056454 | 408 | 9.231 | 0.023318 |
| 408 | 0.279 | 0.061234 | 408 | 4.235 | 0.035078 | 409 | 9.211 | 0.020805 |
| 409 | 0.219 | 0.054102 | 409 | 4.222 | 0.022755 | 410 | 9.189 | 0.019111 |
| 410 | 0.170 | 0.047002 | 410 | 4.209 | 0.016079 | 411 | 9.174 | 0.017860 |
| 411 | 0.125 | 0.040306 | 411 | 4.194 | 0.012528 | 412 | 9.156 | 0.016825 |
| 412 | 0.086 | 0.034003 | 412 | 4.188 | 0.010707 | 413 | 9.140 | 0.016005 |
| 413 | 0.061 | 0.027843 | 413 | 4.174 | 0.009611 | 414 | 9.123 | 0.015229 |
| 414 | 0.034 | 0.022130 | 414 | 4.167 | 0.008962 | 415 | 9.111 | 0.014657 |
| 415 | 0.019 | 0.017826 | 415 | 4.158 | 0.008400 | 416 | 9.097 | 0.014010 |
| 416 | 0.007 | 0.012878 | 416 | 4.150 | 0.008224 | 417 | 9.082 | 0.013428 |
| 417 | -0.004 | 0.008903 | 417 | 4.144 | 0.007925 | 418 | 9.069 | 0.012931 |
| 418 | -0.008 | 0.005961 | 418 | 4.135 | 0.007410 | 419 | 9.056 | 0.012511 |
| 419 | -0.012 | 0.003789 | 419 | 4.129 | 0.007126 | 420 | 9.043 | 0.012069 |
| 420 | -0.036 | 0.002411 | 420 | 4.126 | 0.006859 | 421 | 9.034 | 0.011605 |
| 421 | -0.007 | 0.001520 | 421 | 4.111 | 0.006799 | 422 | 9.021 | 0.011281 |
| 422 | -0.013 | 0.000974 | 422 | 4.108 | 0.006473 | 423 | 9.010 | 0.011066 |
| 423 | -0.015 | 0.000699 | 423 | 4.101 | 0.006238 | 424 | 9.000 | 0.010904 |
| 424 | -0.016 | 0.000586 | 424 | 4.096 | 0.006037 | 425 | 8.988 | 0.010724 |
| 425 | -0.017 | 0.001949 | 425 | 4.090 | 0.005839 | 426 | 8.979 | 0.010500 |
| 426 | -0.018 | 0.001712 | 426 | 4.085 | 0.005936 | 427 | 8.967 | 0.010319 |
| 427 | -0.018 | 0.000741 | 427 | 4.076 | 0.005861 | 428 | 8.958 | 0.010168 |
| 428 | -0.020 | 0.000832 | 428 | 4.069 | 0.005542 | 429 | 8.944 | 0.010042 |
| 429 | -0.021 | 0.000191 | 429 | 4.067 | 0.005500 | 430 | 8.938 | 0.009819 |
| 430 | -0.043 | 0.000161 | 430 | 4.060 | 0.005360 | 431 | 8.929 | 0.009685 |
| 431 | -0.024 | 0.000206 | 431 | 4.055 | 0.005471 | 432 | 8.917 | 0.009640 |
| 432 | -0.013 | 0.000231 | 432 | 4.051 | 0.005386 | 433 | 8.909 | 0.009580 |
| 433 | -0.005 | 0.000085 | 433 | 4.044 | 0.005388 | 434 | 8.901 | 0.009594 |
| 434 | -0.020 | 0.000074 | 434 | 4.040 | 0.005373 | 435 | 8.889 | 0.009565 |
| 435 | -0.024 | 0.000735 | 435 | 4.033 | 0.005259 | 436 | 8.879 | 0.009418 |
| 436 | -0.025 | 0.001030 | 436 | 4.029 | 0.005221 | 437 | 8.871 | 0.009368 |
| 437 | -0.024 | 0.000886 | 437 | 4.022 | 0.005204 | 438 | 8.863 | 0.009298 |
| 438 | -0.023 | 0.001085 | 438 | 4.018 | 0.005106 | 439 | 8.850 | 0.009393 |
| 439 | -0.026 | 0.000401 | 439 | 4.012 | 0.005061 | 440 | 8.843 | 0.009368 |
| 440 | -0.025 | 0.000211 | 440 | 4.008 | 0.005053 | 441 | 8.835 | 0.009162 |

Table A-1: Continued

| Pure PMMA, 10 C/min | | | 5wt% ZrP in PMMA, 10 C/min | | | 10wt% ZrP in PMMA, 10 C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 441 | -0.028 | 0.000331 | 441 | 4.003 | 0.005116 | 442 | 8.825 | 0.009202 |
| 442 | -0.026 | 0.000365 | 442 | 4.000 | 0.005080 | 443 | 8.814 | 0.009166 |
| 443 | -0.027 | 0.000828 | 443 | 3.994 | 0.005081 | 444 | 8.801 | 0.009151 |
| 444 | -0.025 | 0.000278 | 444 | 3.985 | 0.005175 | 445 | 8.797 | 0.009269 |
| 445 | -0.027 | 0.000201 | 445 | 3.980 | 0.005138 | 446 | 8.786 | 0.009228 |
| 446 | -0.038 | 0.000454 | 446 | 3.978 | 0.005187 | 447 | 8.776 | 0.009288 |
| 447 | -0.024 | 0.000629 | 447 | 3.974 | 0.005221 | 448 | 8.768 | 0.009295 |
| 448 | -0.058 | 0.000514 | 448 | 3.968 | 0.005201 | 449 | 8.762 | 0.009426 |
| 449 | -0.023 | 0.000535 | 449 | 3.962 | 0.005218 | 450 | 8.749 | 0.009591 |
| 450 | -0.029 | 0.000318 | 450 | 3.958 | 0.005231 | 451 | 8.741 | 0.009437 |
| 451 | -0.030 | 0.000187 | 451 | 3.951 | 0.005278 | 452 | 8.732 | 0.009489 |
| 452 | -0.031 | 0.000276 | 452 | 3.947 | 0.005306 | 453 | 8.723 | 0.009538 |
| 453 | -0.032 | 0.000335 | 453 | 3.941 | 0.005243 | 454 | 8.713 | 0.009547 |
| 454 | -0.032 | 0.000485 | 454 | 3.937 | 0.005262 | 455 | 8.703 | 0.009621 |
| 455 | -0.031 | 0.000392 | 455 | 3.930 | 0.005318 | 456 | 8.696 | 0.009733 |
| 456 | -0.032 | 0.000353 | 456 | 3.925 | 0.005367 | 457 | 8.684 | 0.009749 |
| 457 | -0.032 | 0.000397 | 457 | 3.919 | 0.005415 | 458 | 8.673 | 0.009786 |
| 458 | -0.033 | 0.000497 | 458 | 3.915 | 0.005465 | 459 | 8.662 | 0.009749 |
| 459 | -0.034 | 0.000582 | 459 | 3.908 | 0.005504 | 460 | 8.654 | 0.009750 |
| 460 | -0.035 | 0.000704 | 460 | 3.904 | 0.005543 | 461 | 8.642 | 0.009846 |
| 461 | -0.034 | 0.000689 | 461 | 3.899 | 0.005503 | 462 | 8.635 | 0.009851 |
| 462 | -0.035 | 0.000537 | 462 | 3.892 | 0.005569 | 463 | 8.626 | 0.009858 |
| 463 | -0.036 | 0.000504 | 463 | 3.886 | 0.005595 | 464 | 8.615 | 0.009910 |
| 464 | -0.036 | 0.000440 | 464 | 3.882 | 0.005630 | 465 | 8.605 | 0.010095 |
| 465 | -0.039 | 0.000332 | 465 | 3.875 | 0.005746 | 466 | 8.595 | 0.010307 |
| 466 | -0.037 | 0.000282 | 466 | 3.869 | 0.005799 | 467 | 8.586 | 0.010325 |
| 467 | -0.036 | 0.000317 | 467 | 3.864 | 0.005821 | 468 | 8.577 | 0.010435 |
| 468 | -0.039 | 0.000956 | 468 | 3.857 | 0.005923 | 469 | 8.563 | 0.010442 |
| 469 | -0.037 | 0.000353 | 469 | 3.850 | 0.005912 | 470 | 8.554 | 0.010393 |
| 470 | -0.037 | 0.000528 | 470 | 3.845 | 0.005965 | 471 | 8.541 | 0.010524 |
| 471 | -0.039 | 0.000898 | 471 | 3.841 | 0.006161 | 472 | 8.533 | 0.010544 |
| 472 | -0.041 | 0.000386 | 472 | 3.832 | 0.005946 | 473 | 8.524 | 0.010539 |
| 473 | -0.023 | -0.000055 | 473 | 3.826 | 0.005974 | 474 | 8.519 | 0.010554 |
| 474 | -0.066 | -0.000095 | 474 | 3.824 | 0.006022 | 475 | 8.501 | 0.010622 |
| 475 | -0.028 | -0.000194 | 475 | 3.815 | 0.006091 | 476 | 8.489 | 0.010818 |
| 476 | -0.065 | -0.000247 | 476 | 3.808 | 0.006116 | 477 | 8.479 | 0.010904 |
| 477 | -0.022 | -0.000119 | 477 | 3.816 | 0.006101 | 478 | 8.470 | 0.011076 |
| 478 | -0.037 | 0.000778 | 478 | 3.798 | 0.006196 | 479 | 8.456 | 0.011141 |
| 479 | -0.043 | 0.000013 | 479 | 3.790 | 0.006148 | 480 | 8.446 | 0.011066 |
| 480 | -0.042 | 0.000584 | 480 | 3.782 | 0.006142 | 481 | 8.435 | 0.011152 |
| 481 | -0.044 | 0.000802 | 481 | 3.779 | 0.006639 | 482 | 8.422 | 0.011195 |
| 482 | -0.046 | 0.000906 | 482 | 3.773 | 0.006601 | 483 | 8.411 | 0.011260 |
| 483 | -0.044 | 0.000518 | 483 | 3.764 | 0.006297 | 484 | 8.403 | 0.011357 |
| 484 | -0.045 | 0.000443 | 484 | 3.760 | 0.006391 | 485 | 8.390 | 0.011292 |
| 485 | -0.045 | 0.000414 | 485 | 3.753 | 0.006399 | 486 | 8.377 | 0.011389 |
| 486 | -0.045 | 0.000380 | 486 | 3.738 | 0.006361 | 487 | 8.364 | 0.011432 |
| 487 | -0.048 | 0.000501 | 487 | 3.739 | 0.006412 | 488 | 8.356 | 0.011443 |
| 488 | -0.047 | 0.000536 | 488 | 3.734 | 0.006520 | 489 | 8.338 | 0.011529 |
| 489 | -0.047 | 0.000627 | 489 | 3.727 | 0.006456 | 490 | 8.330 | 0.011508 |
| 490 | -0.048 | 0.000653 | 490 | 3.723 | 0.006386 | 491 | 8.321 | 0.011508 |
| 491 | -0.047 | 0.001164 | 491 | 3.713 | 0.006505 | 492 | 8.315 | 0.011594 |
| 492 | -0.053 | 0.000115 | 492 | 3.708 | 0.006627 | 493 | 8.298 | 0.011831 |
| 493 | -0.050 | 0.000132 | 493 | 3.699 | 0.006362 | 494 | 8.286 | 0.011626 |
| 494 | -0.059 | 0.000098 | 494 | 3.697 | 0.006425 | 495 | 8.275 | 0.011648 |
| 495 | -0.047 | 0.000034 | 495 | 3.690 | 0.006537 | 496 | 8.261 | 0.011723 |
| 496 | -0.046 | 0.000025 | 496 | 3.683 | 0.006443 | 497 | 8.252 | 0.011702 |
| 497 | -0.048 | 0.000791 | 497 | 3.675 | 0.006544 | 498 | 8.224 | 0.011626 |
| 498 | -0.050 | -0.000166 | 498 | 3.670 | 0.006628 | 499 | 8.227 | 0.011616 |
| 499 | -0.051 | -0.000136 | 499 | 3.662 | 0.006618 | 500 | 8.213 | 0.011659 |
| 500 | -0.051 | 0.000089 | 500 | 3.652 | 0.006540 | 501 | 8.198 | 0.011551 |
| 501 | -0.050 | 0.000918 | 501 | 3.648 | 0.006448 | 502 | 8.188 | 0.011648 |
| 502 | -0.046 | 0.000063 | 502 | 3.641 | 0.006359 | 503 | 8.178 | 0.011810 |
| 503 | -0.046 | 0.000084 | 503 | 3.637 | 0.006314 | 504 | 8.169 | 0.011475 |
| 504 | -0.051 | 0.000035 | 504 | 3.630 | 0.006234 | 505 | 8.159 | 0.011519 |
| 505 | -0.050 | -0.000080 | 505 | 3.622 | 0.006247 | 506 | 8.147 | 0.011454 |
| 506 | -0.052 | -0.000098 | 506 | 3.618 | 0.006212 | 507 | 8.131 | 0.011508 |
| 507 | -0.051 | 0.000939 | 507 | 3.610 | 0.006210 | 508 | 8.128 | 0.011551 |

Table A-1: Continued

| Pure PMMA, 10 C/min | | | 5wt% ZrP in PMMA, 10 C/min | | | 10wt% ZrP in PMMA, 10 C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 508 | -0.051 | 0.000136 | 508 | 3.603 | 0.006234 | 509 | 8.104 | 0.011389 |
| 509 | -0.049 | 0.000065 | 509 | 3.599 | 0.006104 | 510 | 8.102 | 0.011346 |
| 510 | -0.050 | 0.000117 | 510 | 3.594 | 0.005985 | 511 | 8.089 | 0.011281 |
| 511 | -0.051 | 0.000198 | 511 | 3.586 | 0.005999 | 512 | 8.077 | 0.011249 |
| 512 | -0.052 | 0.000294 | 512 | 3.581 | 0.005970 | 513 | 8.068 | 0.011389 |
| 513 | -0.052 | 0.000342 | 513 | 3.574 | 0.006025 | 514 | 8.055 | 0.010850 |
| 514 | -0.053 | 0.000327 | 514 | 3.571 | 0.005979 | 515 | 8.046 | 0.010839 |
| 515 | -0.052 | 0.000191 | 515 | 3.564 | 0.005942 | 516 | 8.032 | 0.010807 |
| 516 | -0.054 | 0.000075 | 516 | 3.556 | 0.005921 | 517 | 8.022 | 0.011044 |
| 517 | -0.053 | -0.000002 | 517 | 3.550 | 0.005823 | 518 | 8.003 | 0.010893 |
| 518 | -0.052 | -0.000091 | 518 | 3.545 | 0.005727 | 519 | 8.003 | 0.010678 |
| 519 | -0.053 | -0.000142 | 519 | 3.539 | 0.005510 | 520 | 7.991 | 0.010818 |
| 520 | -0.053 | -0.000162 | 520 | 3.533 | 0.005325 | 521 | 7.978 | 0.010672 |
| 521 | -0.053 | -0.000072 | 521 | 3.525 | 0.005274 | 522 | 7.955 | 0.010261 |
| 522 | -0.051 | 0.000048 | 522 | 3.523 | 0.005344 | 523 | 7.961 | 0.010159 |
| 523 | -0.053 | 0.000204 | 523 | 3.516 | 0.005461 | 524 | 7.948 | 0.009804 |
| 524 | -0.052 | 0.000216 | 524 | 3.513 | 0.005430 | 525 | 7.937 | 0.009750 |
| 525 | -0.053 | 0.000960 | 525 | 3.507 | 0.005416 | 526 | 7.931 | 0.009689 |
| 526 | -0.053 | 0.000285 | 526 | 3.502 | 0.005229 | 527 | 7.923 | 0.009865 |
| 527 | -0.059 | -0.000097 | 527 | 3.496 | 0.005122 | 528 | 7.911 | 0.009753 |
| 528 | -0.053 | -0.000103 | 528 | 3.490 | 0.005057 | 529 | 7.899 | 0.009799 |
| 529 | -0.054 | 0.000285 | 529 | 3.485 | 0.004930 | 530 | 7.894 | 0.009985 |
| 530 | -0.091 | 0.000218 | 530 | 3.483 | 0.004806 | 531 | 7.881 | 0.009586 |
| 531 | -0.033 | 0.000548 | 531 | 3.480 | 0.004698 | 532 | 7.870 | 0.009122 |
| 532 | -0.065 | 0.000381 | 532 | 3.472 | 0.004667 | 533 | 7.863 | 0.008861 |
| 533 | -0.047 | 0.000256 | 533 | 3.465 | 0.004740 | 534 | 7.847 | 0.009039 |
| 534 | -0.086 | -0.000105 | 534 | 3.463 | 0.004709 | 535 | 7.842 | 0.008938 |
| 535 | -0.080 | 0.000521 | 535 | 3.459 | 0.004710 | 536 | 7.839 | 0.008405 |
| 536 | -0.055 | -0.000107 | 536 | 3.452 | 0.004501 | 537 | 7.828 | 0.008371 |
| 537 | -0.054 | -0.000916 | 537 | 3.450 | 0.004256 | 538 | 7.819 | 0.008315 |
| 538 | -0.052 | -0.000990 | 538 | 3.444 | 0.004262 | 539 | 7.804 | 0.008547 |
| 539 | -0.050 | -0.001023 | 539 | 3.442 | 0.004203 | 540 | 7.801 | 0.008813 |
| 540 | -0.059 | -0.001050 | 540 | 3.434 | 0.004099 | 541 | 7.793 | 0.008126 |
| 541 | -0.053 | -0.000056 | 541 | 3.435 | 0.003975 | 542 | 7.784 | 0.007858 |
| 542 | -0.038 | -0.000246 | 542 | 3.429 | 0.003881 | 543 | 7.777 | 0.007760 |
| 543 | -0.055 | -0.000162 | 543 | 3.422 | 0.003854 | 544 | 7.763 | 0.007951 |
| 544 | -0.048 | -0.000231 | 544 | 3.422 | 0.003755 | 545 | 7.761 | 0.007874 |
| 545 | -0.051 | 0.000082 | 545 | 3.418 | 0.003730 | 546 | 7.761 | 0.007416 |
| 546 | -0.054 | -0.000211 | 546 | 3.413 | 0.003651 | 547 | 7.746 | 0.007288 |
| 547 | -0.049 | -0.000040 | 547 | 3.411 | 0.003582 | 548 | 7.738 | 0.007154 |
| 548 | -0.051 | -0.000234 | 548 | 3.404 | 0.003616 | 549 | 7.732 | 0.007043 |
| 549 | -0.051 | -0.000170 | 549 | 3.405 | 0.003659 | 550 | 7.724 | 0.007294 |
| 550 | -0.050 | -0.000258 | 550 | 3.400 | 0.003537 | 551 | 7.717 | 0.007032 |
| 551 | -0.050 | 0.000053 | 551 | 3.394 | 0.003507 | 552 | 7.711 | 0.006826 |
| 552 | -0.051 | -0.000071 | 552 | 3.393 | 0.003465 | 553 | 7.704 | 0.006777 |
| 553 | -0.048 | -0.000152 | 553 | 3.391 | 0.003318 | 554 | 7.695 | 0.006680 |
| 554 | -0.050 | -0.000143 | 554 | 3.383 | 0.003204 | 555 | 7.691 | 0.006542 |
| 555 | -0.049 | -0.000157 | 555 | 3.382 | 0.003117 | 556 | 7.686 | 0.006476 |
| 556 | -0.050 | -0.000186 | 556 | 3.380 | 0.003003 | 557 | 7.675 | 0.006457 |
| 557 | -0.050 | -0.000173 | 557 | 3.375 | 0.002988 | 558 | 7.679 | 0.006236 |
| 558 | -0.049 | -0.000060 | 558 | 3.373 | 0.002850 | 559 | 7.665 | 0.006189 |
| 559 | -0.050 | -0.000111 | 559 | 3.370 | 0.002812 | 560 | 7.659 | 0.006117 |
| 560 | -0.049 | -0.000124 | 560 | 3.368 | 0.002725 | 561 | 7.652 | 0.005979 |
| 561 | -0.048 | -0.000183 | 561 | 3.361 | 0.002670 | 562 | 7.641 | 0.005867 |
| 562 | -0.051 | -0.000177 | 562 | 3.361 | 0.002704 | 563 | 7.642 | 0.005858 |
| 563 | -0.051 | -0.000070 | 563 | 3.357 | 0.002545 | 564 | 7.635 | 0.005657 |
| 564 | -0.048 | -0.000311 | 564 | 3.359 | 0.002545 | 565 | 7.628 | 0.005486 |
| 565 | -0.049 | -0.000284 | 565 | 3.357 | 0.002455 | 566 | 7.624 | 0.005430 |
| 566 | -0.048 | -0.000386 | 566 | 3.350 | 0.002498 | 567 | 7.621 | 0.005360 |
| 567 | -0.045 | -0.000256 | 567 | 3.350 | 0.002492 | 568 | 7.613 | 0.005212 |
| 568 | -0.072 | -0.000218 | 568 | 3.348 | 0.002398 | 569 | 7.608 | 0.005177 |
| 569 | -0.046 | -0.000137 | 569 | 3.346 | 0.002462 | 570 | 7.605 | 0.005090 |
| 570 | -0.048 | 0.000039 | 570 | 3.344 | 0.002418 | 571 | 7.597 | 0.004956 |
| 571 | -0.047 | 0.000074 | 571 | 3.339 | 0.002321 | 572 | 7.592 | 0.004861 |
| 572 | -0.051 | -0.000036 | 572 | 3.339 | 0.002251 | 573 | 7.588 | 0.004785 |
| 573 | -0.044 | -0.000049 | 573 | 3.333 | 0.002168 | 574 | 7.581 | 0.004693 |
| 574 | -0.052 | -0.000127 | 574 | 3.334 | 0.002099 | 575 | 7.579 | 0.004535 |

Table A-1: Continued

| Pure PMMA, 10 C/min | | | 5wt% ZrP in PMMA, 10 C/min | | | 10wt% ZrP in PMMA, 10 C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 575 | -0.048 | -0.000229 | 575 | 3.331 | 0.001947 | 576 | 7.575 | 0.004480 |
| 576 | -0.047 | -0.000356 | 576 | 3.331 | 0.001893 | 577 | 7.571 | 0.004420 |
| 577 | -0.047 | -0.000256 | 577 | 3.328 | 0.001868 | 578 | 7.565 | 0.004330 |
| 578 | -0.046 | -0.000334 | 578 | 3.324 | 0.001749 | 579 | 7.555 | 0.004415 |
| 579 | -0.044 | -0.000401 | 579 | 3.324 | 0.001805 | 580 | 7.557 | 0.004262 |
| 580 | -0.044 | -0.000117 | 580 | 3.322 | 0.001583 | 581 | 7.553 | 0.004094 |
| 581 | -0.046 | -0.000076 | 581 | 3.321 | 0.001563 | 582 | 7.554 | 0.004294 |
| 582 | -0.045 | -0.000163 | 582 | 3.319 | 0.001494 | 583 | 7.543 | 0.003975 |
| 583 | -0.045 | -0.000173 | 583 | 3.317 | 0.001498 | 584 | 7.536 | 0.003906 |
| 584 | -0.045 | -0.000165 | 584 | 3.318 | 0.001473 | 585 | 7.543 | 0.003837 |
| 585 | -0.047 | -0.000227 | 585 | 3.317 | 0.001416 | 586 | 7.533 | 0.003700 |
| 586 | -0.037 | -0.000180 | 586 | 3.313 | 0.001438 | 587 | 7.531 | 0.004063 |
| 587 | -0.047 | -0.000139 | 587 | 3.308 | 0.001637 | 588 | 7.528 | 0.003544 |
| 588 | -0.043 | 0.000005 | 588 | 3.312 | 0.001643 | 589 | 7.523 | 0.003524 |
| 589 | -0.044 | -0.000188 | 589 | 3.307 | 0.001620 | 590 | 7.516 | 0.003356 |
| 590 | -0.044 | -0.000168 | 590 | 3.306 | 0.001564 | 591 | 7.513 | 0.003163 |
| 591 | -0.043 | -0.000118 | 591 | 3.306 | 0.001510 | 592 | 7.510 | 0.003405 |
| 592 | -0.047 | -0.000279 | 592 | 3.303 | 0.001510 | 593 | 7.520 | 0.003142 |
| 593 | -0.051 | -0.000296 | 593 | 3.303 | 0.001379 | 594 | 7.505 | 0.003337 |
| 594 | -0.040 | -0.000319 | 594 | 3.299 | 0.001243 | 595 | 7.502 | 0.003061 |
| 595 | -0.040 | -0.000283 | 595 | 3.299 | 0.001194 | 596 | 7.499 | 0.002886 |
| 596 | -0.042 | -0.000017 | 596 | 3.299 | 0.001186 | 597 | 7.495 | 0.003295 |
| 597 | -0.043 | -0.000019 | 597 | 3.299 | 0.001203 | 598 | 7.491 | 0.003116 |
| 598 | -0.042 | -0.000066 | 598 | 3.298 | 0.001264 | 599 | 7.489 | 0.002977 |
| 599 | -0.042 | -0.000041 | 599 | 3.296 | 0.001169 | 600 | 7.485 | 0.002831 |
| 600 | -0.040 | -0.000251 | 600 | 3.292 | 0.001136 | 601 | 7.487 | 0.002769 |
| 601 | -0.045 | -0.000342 | 601 | 3.293 | 0.001191 | 602 | 7.483 | 0.002726 |
| 602 | -0.036 | -0.000388 | 602 | 3.292 | 0.001297 | 603 | 7.477 | 0.002621 |
| 603 | -0.042 | -0.000374 | 603 | 3.290 | 0.001179 | 604 | 7.474 | 0.002848 |
| 604 | -0.041 | -0.000322 | 604 | 3.290 | 0.001058 | 605 | 7.474 | 0.002539 |
| 605 | -0.039 | -0.000266 | 605 | 3.291 | 0.001012 | 606 | 7.471 | 0.002427 |
| 606 | -0.040 | -0.000071 | 606 | 3.284 | 0.001030 | 607 | 7.469 | 0.002527 |
| 607 | -0.037 | 0.000111 | 607 | 3.286 | 0.000977 | 608 | 7.464 | 0.002381 |
| 608 | -0.041 | 0.000173 | 608 | 3.285 | 0.001021 | 609 | 7.463 | 0.002359 |
| 609 | -0.041 | -0.000071 | 609 | 3.285 | 0.000970 | 610 | 7.461 | 0.002351 |
| 610 | -0.040 | -0.000191 | 610 | 3.283 | 0.000817 | 611 | 7.458 | 0.002306 |
| 611 | -0.041 | -0.000137 | 611 | 3.281 | 0.000803 | 612 | 7.451 | 0.002402 |
| 612 | -0.040 | -0.000342 | 612 | 3.280 | 0.000873 | 613 | 7.455 | 0.002290 |
| 613 | -0.048 | -0.000400 | 613 | 3.280 | 0.000851 | 614 | 7.450 | 0.002310 |
| 614 | -0.037 | -0.000392 | 614 | 3.281 | 0.000792 | 615 | 7.451 | 0.002224 |
| 615 | -0.039 | -0.000311 | 615 | 3.277 | 0.000774 | 616 | 7.439 | 0.002089 |
| 616 | -0.038 | -0.000248 | 616 | 3.279 | 0.000811 | 617 | 7.445 | 0.002208 |
| 617 | -0.035 | -0.000261 | 617 | 3.277 | 0.000769 | 618 | 7.444 | 0.002192 |
| 618 | -0.038 | 0.000060 | 618 | 3.274 | 0.000825 | 619 | 7.441 | 0.002075 |
| 619 | -0.038 | -0.000171 | 619 | 3.277 | 0.000731 | 620 | 7.440 | 0.002028 |
| 620 | -0.037 | -0.000340 | 620 | 3.274 | 0.000657 | 621 | 7.439 | 0.001878 |
| 621 | -0.036 | -0.000134 | 621 | 3.274 | 0.000592 | 622 | 7.434 | 0.001925 |
| 622 | -0.036 | -0.000277 | 622 | 3.272 | 0.000550 | 623 | 7.429 | 0.001941 |
| 623 | -0.038 | -0.000289 | 623 | 3.273 | 0.000469 | 624 | 7.434 | 0.002053 |
| 624 | -0.035 | -0.000283 | 624 | 3.273 | 0.000474 | 625 | 7.429 | 0.001901 |
| 625 | -0.036 | -0.000272 | 625 | 3.271 | 0.000477 | 626 | 7.430 | 0.002031 |
| 626 | -0.037 | -0.000198 | 626 | 3.270 | 0.000522 | 627 | 7.423 | 0.001677 |
| 627 | -0.036 | -0.000110 | 627 | 3.272 | 0.000506 | 628 | 7.422 | 0.001761 |
| 628 | -0.036 | -0.000263 | 628 | 3.272 | 0.000540 | 629 | 7.425 | 0.001812 |
| 629 | -0.036 | 0.000010 | 629 | 3.268 | 0.000454 | 630 | 7.419 | 0.001835 |
| 630 | -0.035 | -0.000325 | 630 | 3.273 | 0.000522 | 631 | 7.414 | 0.001682 |
| 631 | -0.035 | -0.000308 | 631 | 3.268 | 0.000515 | 632 | 7.416 | 0.001613 |
| 632 | -0.031 | -0.000313 | 632 | 3.267 | 0.000479 | 633 | 7.417 | 0.001631 |
| 633 | -0.035 | -0.000353 | 633 | 3.269 | 0.000380 | 634 | 7.413 | 0.001739 |
| 634 | -0.038 | -0.000328 | 634 | 3.272 | 0.000313 | 635 | 7.415 | 0.001553 |
| 635 | -0.034 | -0.000327 | 635 | 3.268 | 0.000358 | 636 | 7.407 | 0.001824 |
| 636 | -0.032 | -0.000284 | 636 | 3.267 | 0.000361 | 637 | 7.405 | 0.001387 |
| 637 | -0.032 | -0.000253 | 637 | 3.267 | 0.000341 | 638 | 7.410 | 0.001363 |
| 638 | -0.030 | -0.000415 | 638 | 3.268 | 0.000444 | 639 | 7.406 | 0.001420 |
| 639 | -0.037 | -0.000152 | 639 | 3.267 | 0.000451 | 640 | 7.406 | 0.001576 |
| 640 | -0.033 | -0.000279 | 640 | 3.263 | 0.000549 | 641 | 7.413 | 0.001424 |
| 641 | -0.025 | -0.000251 | 641 | 3.268 | 0.000520 | 642 | 7.401 | 0.001432 |

Table A-1: Continued

| Pure PMMA, 10 C/min | | | 5wt% ZrP in PMMA, 10 C/min | | | 10wt% ZrP in PMMA, 10 C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 642 | -0.032 | -0.000253 | 642 | 3.263 | 0.000427 | 643 | 7.400 | 0.001438 |
| 643 | -0.032 | -0.000338 | 643 | 3.262 | 0.000404 | 644 | 7.401 | 0.001406 |
| 644 | -0.031 | -0.000365 | 644 | 3.261 | 0.000466 | 645 | 7.396 | 0.001356 |
| 645 | -0.029 | -0.000297 | 645 | 3.265 | 0.000348 | 646 | 7.396 | 0.001457 |
| 646 | -0.022 | -0.000143 | 646 | 3.265 | 0.000332 | 647 | 7.392 | 0.001401 |
| 647 | -0.023 | -0.000184 | 647 | 3.262 | 0.000232 | 648 | 7.394 | 0.001366 |
| 648 | -0.033 | -0.000349 | 648 | 3.262 | 0.000324 | 649 | 7.391 | 0.001368 |
| 649 | -0.029 | -0.000293 | 649 | 3.262 | 0.000365 | 650 | 7.390 | 0.001488 |
| 650 | -0.029 | -0.000335 | 650 | 3.263 | 0.000424 | 651 | 7.390 | 0.001390 |
| 651 | -0.028 | -0.000331 | 651 | 3.263 | 0.000279 | 652 | 7.390 | 0.001236 |
| 652 | -0.038 | -0.000248 | 652 | 3.260 | 0.000101 | 653 | 7.387 | 0.001165 |
| 653 | -0.027 | -0.000271 | 653 | 3.259 | 0.000121 | 654 | 7.384 | 0.001168 |
| 654 | -0.029 | -0.000216 | 654 | 3.261 | 0.000194 | 655 | 7.385 | 0.001059 |
| 655 | -0.026 | -0.000166 | 655 | 3.261 | 0.000178 | 656 | 7.387 | 0.000982 |
| 656 | -0.028 | -0.000168 | 656 | 3.261 | 0.000116 | 657 | 7.385 | 0.001099 |
| 657 | -0.031 | -0.000045 | 657 | 3.260 | 0.000121 | 658 | 7.385 | 0.000937 |
| 658 | -0.028 | -0.000177 | 658 | 3.260 | 0.000285 | 659 | 7.378 | 0.000872 |
| 659 | -0.026 | -0.000033 | 659 | 3.261 | 0.000275 | 660 | 7.378 | 0.001114 |
| 660 | -0.029 | -0.000152 | 660 | 3.260 | 0.000244 | 661 | 7.377 | 0.001112 |
| 661 | -0.027 | -0.000342 | 661 | 3.260 | 0.000127 | 662 | 7.379 | 0.000956 |
| 662 | -0.026 | -0.000383 | 662 | 3.257 | 0.000150 | 663 | 7.377 | 0.000923 |
| 663 | -0.027 | -0.000253 | 663 | 3.261 | 0.000196 | 664 | 7.376 | 0.001007 |
| 664 | -0.030 | -0.000207 | 664 | 3.258 | 0.000082 | 665 | 7.372 | 0.001001 |
| 665 | -0.025 | -0.000336 | 665 | 3.261 | 0.000122 | 666 | 7.374 | 0.001117 |
| 666 | -0.026 | -0.000389 | 666 | 3.259 | -0.000008 | 667 | 7.373 | 0.001009 |
| 667 | -0.024 | -0.000358 | 667 | 3.256 | 0.000045 | 668 | 7.372 | 0.001013 |
| 668 | -0.032 | -0.000396 | 668 | 3.259 | 0.000199 | 669 | 7.371 | 0.000977 |
| 669 | -0.015 | -0.000424 | 669 | 3.257 | -0.000036 | 670 | 7.368 | 0.001534 |
| 670 | -0.023 | -0.000415 | 670 | 3.262 | 0.000055 | 671 | 7.363 | 0.001922 |
| 671 | -0.024 | -0.000376 | 671 | 3.258 | 0.000063 | 672 | 7.369 | 0.002201 |
| 672 | -0.026 | -0.000389 | 672 | 3.257 | 0.000138 | 673 | 7.352 | 0.002341 |
| 673 | -0.020 | -0.000359 | 673 | 3.259 | 0.000243 | 674 | 7.364 | 0.002340 |
| 674 | -0.022 | -0.000084 | 674 | 3.258 | 0.000065 | 675 | 7.359 | 0.002197 |
| 675 | -0.021 | -0.000176 | 675 | 3.257 | 0.000070 | 676 | 7.359 | 0.002120 |
| 676 | -0.022 | -0.000199 | 676 | 3.254 | -0.000089 | 677 | 7.352 | 0.001718 |
| 677 | -0.022 | 0.000120 | 677 | 3.260 | -0.000003 | 678 | 7.352 | 0.001360 |
| 678 | -0.022 | 0.000138 | 678 | 3.258 | 0.000083 | 679 | 7.352 | 0.000918 |
| 679 | -0.021 | -0.000412 | 679 | 3.258 | -0.000199 | 680 | 7.352 | 0.000829 |
| 680 | -0.022 | -0.000529 | 680 | 3.258 | -0.000141 | 681 | 7.349 | 0.000910 |
| 681 | -0.021 | -0.000369 | 681 | 3.259 | -0.000097 | 682 | 7.350 | 0.000697 |
| 682 | -0.035 | -0.000452 | 682 | 3.258 | -0.000041 | 683 | 7.344 | 0.000720 |
| 683 | -0.005 | -0.000419 | 683 | 3.258 | 0.000043 | 684 | 7.346 | 0.000610 |
| 684 | -0.019 | -0.000404 | 684 | 3.259 | 0.000002 | 685 | 7.358 | 0.000374 |
| 685 | -0.019 | -0.000384 | 685 | 3.258 | -0.000047 | 686 | 7.340 | 0.000351 |
| 686 | -0.021 | -0.000380 | 686 | 3.257 | -0.000110 | 687 | 7.343 | 0.000416 |
| 687 | -0.019 | -0.000157 | 687 | 3.260 | -0.000085 | 688 | 7.345 | 0.000378 |
| 688 | -0.020 | 0.000108 | 688 | 3.258 | 0.000000 | 689 | 7.348 | 0.000301 |
| 689 | -0.019 | -0.000274 | 689 | 3.258 | -0.000015 | 690 | 7.346 | 0.002178 |
| 690 | -0.019 | -0.000717 | 690 | 3.259 | -0.000014 | 691 | 7.347 | 0.004214 |
| 691 | -0.018 | -0.000573 | 691 | 3.260 | -0.000047 | 692 | 7.347 | 0.005564 |
| 692 | -0.017 | -0.000443 | 692 | 3.257 | -0.000070 | 693 | 7.341 | 0.006674 |
| 693 | -0.024 | -0.000627 | 693 | 3.258 | -0.000106 | 694 | 7.349 | 0.007077 |
| 694 | 0.002 | -0.000633 | 694 | 3.260 | -0.000028 | 695 | 7.302 | 0.006835 |
| 695 | -0.016 | -0.000532 | 695 | 3.259 | -0.000035 | 696 | 7.296 | 0.006021 |
| 696 | -0.015 | -0.000472 | 696 | 3.258 | -0.000094 | 697 | 7.297 | 0.005249 |
| 697 | -0.022 | -0.000262 | 697 | 3.260 | -0.000225 | 698 | 7.299 | 0.003480 |
| 698 | -0.012 | -0.000185 | 698 | 3.260 | -0.000169 | 699 | 7.294 | 0.001212 |
| 699 | -0.014 | 0.000204 | 699 | 3.258 | -0.000081 | 700 | 7.298 | 0.000618 |
| 700 | -0.016 | -0.000311 | 700 | 3.259 | -0.000113 | | | |

Table A-2: TGA and DTG for 30wt% ZrP in PMMA

| 30wt% ZrP in PMMA, 10 C/min | | |
|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 250 | 100.0000 | 0.028267 |
| 251 | 99.9779 | 0.028157 |
| 252 | 99.9448 | 0.028124 |
| 253 | 99.9227 | 0.028168 |
| 254 | 99.8896 | 0.028223 |
| 255 | 99.8675 | 0.028377 |
| 256 | 99.8344 | 0.028631 |
| 257 | 99.8124 | 0.028918 |
| 258 | 99.7792 | 0.029249 |
| 259 | 99.7461 | 0.029746 |
| 260 | 99.7241 | 0.030188 |
| 261 | 99.6909 | 0.030728 |
| 262 | 99.6578 | 0.031325 |
| 263 | 99.6247 | 0.032031 |
| 264 | 99.5916 | 0.032837 |
| 265 | 99.5585 | 0.033698 |
| 266 | 99.5254 | 0.034592 |
| 267 | 99.4923 | 0.035585 |
| 268 | 99.4592 | 0.036645 |
| 269 | 99.4150 | 0.037781 |
| 270 | 99.3819 | 0.039007 |
| 271 | 99.3377 | 0.040287 |
| 272 | 99.3046 | 0.041512 |
| 273 | 99.2605 | 0.042848 |
| 274 | 99.2163 | 0.044227 |
| 275 | 99.1722 | 0.045706 |
| 276 | 99.1280 | 0.047130 |
| 277 | 99.0728 | 0.048653 |
| 278 | 99.0287 | 0.050243 |
| 279 | 98.9735 | 0.051898 |
| 280 | 98.9183 | 0.053576 |
| 281 | 98.8742 | 0.055375 |
| 282 | 98.8079 | 0.057152 |
| 283 | 98.7528 | 0.059084 |
| 284 | 98.6976 | 0.060993 |
| 285 | 98.6313 | 0.063057 |
| 286 | 98.5651 | 0.065210 |
| 287 | 98.5099 | 0.067506 |
| 288 | 98.4327 | 0.069890 |
| 289 | 98.3664 | 0.072340 |
| 290 | 98.2892 | 0.074945 |
| 291 | 98.2119 | 0.077660 |
| 292 | 98.1347 | 0.080442 |
| 293 | 98.0574 | 0.083411 |
| 294 | 97.9691 | 0.086104 |
| 295 | 97.8808 | 0.089007 |
| 296 | 97.7925 | 0.091921 |
| 297 | 97.6932 | 0.094890 |
| 298 | 97.6049 | 0.097903 |
| 299 | 97.5055 | 0.100872 |
| 300 | 97.3951 | 0.104029 |
| 301 | 97.2958 | 0.107252 |
| 302 | 97.1854 | 0.110596 |
| 303 | 97.0751 | 0.114128 |
| 304 | 96.9536 | 0.117550 |
| 305 | 96.8433 | 0.121192 |
| 306 | 96.7219 | 0.124945 |
| 307 | 96.5894 | 0.128698 |
| 308 | 96.4570 | 0.132781 |
| 309 | 96.3245 | 0.136645 |
| 310 | 96.1921 | 0.140839 |
| 311 | 96.0486 | 0.145033 |
| 312 | 95.8940 | 0.149338 |
| 313 | 95.7506 | 0.153974 |
| 314 | 95.5850 | 0.158720 |
| 315 | 95.4305 | 0.163687 |
| 316 | 95.2649 | 0.168985 |

Table A-2: Continued
30wt% ZrP in PMMA, 10 C/min

| Temperature (°C) | mass (%) | mass loss rate (%/°C) |
|---|---|---|
| 317 | 95.0993 | 0.174393 |
| 318 | 94.9117 | 0.180022 |
| 319 | 94.7351 | 0.185651 |
| 320 | 94.5475 | 0.191391 |
| 321 | 94.3488 | 0.197130 |
| 322 | 94.1501 | 0.202980 |
| 323 | 93.9404 | 0.209051 |
| 324 | 93.7307 | 0.215232 |
| 325 | 93.5210 | 0.221413 |
| 326 | 93.2892 | 0.227925 |
| 327 | 93.0574 | 0.234547 |
| 328 | 92.8256 | 0.241280 |
| 329 | 92.5828 | 0.248013 |
| 330 | 92.3289 | 0.254746 |
| 331 | 92.0640 | 0.261479 |
| 332 | 91.7991 | 0.268433 |
| 333 | 91.5342 | 0.275276 |
| 334 | 91.2583 | 0.282230 |
| 335 | 90.9713 | 0.289294 |
| 336 | 90.6733 | 0.296358 |
| 337 | 90.3753 | 0.303863 |
| 338 | 90.0662 | 0.311369 |
| 339 | 89.7572 | 0.318874 |
| 340 | 89.4371 | 0.326600 |
| 341 | 89.1060 | 0.334547 |
| 342 | 88.7638 | 0.342826 |
| 343 | 88.4216 | 0.350993 |
| 344 | 88.0684 | 0.359492 |
| 345 | 87.7042 | 0.367991 |
| 346 | 87.3289 | 0.377042 |
| 347 | 86.9426 | 0.386534 |
| 348 | 86.5563 | 0.396358 |
| 349 | 86.1589 | 0.406623 |
| 350 | 85.7506 | 0.417219 |
| 351 | 85.3201 | 0.428146 |
| 352 | 84.8896 | 0.439625 |
| 353 | 84.4481 | 0.451435 |
| 354 | 83.9845 | 0.463355 |
| 355 | 83.5210 | 0.475717 |
| 356 | 83.0353 | 0.488521 |
| 357 | 82.5497 | 0.501656 |
| 358 | 82.0419 | 0.515342 |
| 359 | 81.5232 | 0.529360 |
| 360 | 80.9823 | 0.543929 |
| 361 | 80.4305 | 0.558720 |
| 362 | 79.8675 | 0.573841 |
| 363 | 79.2826 | 0.589514 |
| 364 | 78.6865 | 0.605408 |
| 365 | 78.0795 | 0.621744 |
| 366 | 77.4503 | 0.638631 |
| 367 | 76.7991 | 0.655850 |
| 368 | 76.1369 | 0.673620 |
| 369 | 75.4525 | 0.691832 |
| 370 | 74.7572 | 0.710706 |
| 371 | 74.0397 | 0.730243 |
| 372 | 73.3002 | 0.750221 |
| 373 | 72.5386 | 0.771413 |
| 374 | 71.7660 | 0.793488 |
| 375 | 70.9603 | 0.816777 |
| 376 | 70.1325 | 0.841391 |
| 377 | 69.2826 | 0.867329 |
| 378 | 68.4106 | 0.894812 |
| 379 | 67.5055 | 0.924172 |
| 380 | 66.5673 | 0.954857 |
| 381 | 65.5960 | 0.987528 |
| 382 | 64.6026 | 1.021854 |
| 383 | 63.5651 | 1.058168 |

Table A-2: Continued

30wt% ZrP in PMMA, 10 C/min

| Temperature (°C) | mass (%) | mass loss rate (%/°C) |
|---|---|---|
| 384 | 62.4945 | 1.096137 |
| 385 | 61.3907 | 1.135762 |
| 386 | 60.2318 | 1.176600 |
| 387 | 59.0397 | 1.217439 |
| 388 | 57.7925 | 1.258278 |
| 389 | 56.5121 | 1.300221 |
| 390 | 55.1987 | 1.338852 |
| 391 | 53.8300 | 1.376380 |
| 392 | 52.4283 | 1.410596 |
| 393 | 50.9934 | 1.442605 |
| 394 | 49.5254 | 1.470199 |
| 395 | 48.0243 | 1.493377 |
| 396 | 46.5011 | 1.508830 |
| 397 | 44.9779 | 1.516556 |
| 398 | 43.4327 | 1.515453 |
| 399 | 41.8874 | 1.502208 |
| 400 | 40.3532 | 1.472406 |
| 401 | 38.8742 | 1.423841 |
| 402 | 37.4172 | 1.355408 |
| 403 | 36.0155 | 1.260486 |
| 404 | 34.7351 | 1.141280 |
| 405 | 33.5872 | 1.003753 |
| 406 | 32.6159 | 0.859713 |
| 407 | 31.8322 | 0.704525 |
| 408 | 31.2362 | 0.559051 |
| 409 | 30.8168 | 0.431898 |
| 410 | 30.5188 | 0.323841 |
| 411 | 30.3091 | 0.237528 |
| 412 | 30.1656 | 0.176711 |
| 413 | 30.0442 | 0.131678 |
| 414 | 29.9558 | 0.102483 |
| 415 | 29.8786 | 0.083951 |
| 416 | 29.8124 | 0.071413 |
| 417 | 29.7461 | 0.062660 |
| 418 | 29.6909 | 0.056313 |
| 419 | 29.6358 | 0.051424 |
| 420 | 29.6026 | 0.047693 |
| 421 | 29.5475 | 0.044558 |
| 422 | 29.5143 | 0.041998 |
| 423 | 29.4702 | 0.039834 |
| 424 | 29.4260 | 0.038168 |
| 425 | 29.3929 | 0.036744 |
| 426 | 29.3598 | 0.035464 |
| 427 | 29.3267 | 0.034470 |
| 428 | 29.2826 | 0.033477 |
| 429 | 29.2494 | 0.032539 |
| 430 | 29.2274 | 0.031777 |
| 431 | 29.1943 | 0.031093 |
| 432 | 29.1611 | 0.030530 |
| 433 | 29.1280 | 0.029912 |
| 434 | 29.1060 | 0.029349 |
| 435 | 29.0728 | 0.028918 |
| 436 | 29.0397 | 0.028576 |
| 437 | 29.0177 | 0.028234 |
| 438 | 28.9845 | 0.027892 |
| 439 | 28.9625 | 0.027616 |
| 440 | 28.9294 | 0.027296 |
| 441 | 28.9073 | 0.026987 |
| 442 | 28.8742 | 0.026766 |
| 443 | 28.8521 | 0.026578 |
| 444 | 28.8300 | 0.026325 |
| 445 | 28.7969 | 0.026181 |
| 446 | 28.7748 | 0.026148 |
| 447 | 28.7528 | 0.026026 |
| 448 | 28.7196 | 0.025927 |
| 449 | 28.6976 | 0.025839 |
| 450 | 28.6645 | 0.025740 |

Table A-2: Continued

30wt% ZrP in PMMA, 10 C/min

| Temperature (°C) | mass (%) | mass loss rate (%/°C) |
|---|---|---|
| 451 | 28.6424 | 0.025673 |
| 452 | 28.6203 | 0.025596 |
| 453 | 28.5982 | 0.025563 |
| 454 | 28.5651 | 0.025464 |
| 455 | 28.5430 | 0.025508 |
| 456 | 28.5210 | 0.025728 |
| 457 | 28.4879 | 0.025596 |
| 458 | 28.4658 | 0.025640 |
| 459 | 28.4437 | 0.025640 |
| 460 | 28.4106 | 0.025607 |
| 461 | 28.3885 | 0.025618 |
| 462 | 28.3664 | 0.025673 |
| 463 | 28.3333 | 0.025762 |
| 464 | 28.3113 | 0.025784 |
| 465 | 28.2892 | 0.025828 |
| 466 | 28.2561 | 0.026015 |
| 467 | 28.2340 | 0.026060 |
| 468 | 28.2119 | 0.026104 |
| 469 | 28.1788 | 0.026159 |
| 470 | 28.1567 | 0.026192 |
| 471 | 28.1236 | 0.026236 |
| 472 | 28.1015 | 0.026457 |
| 473 | 28.0795 | 0.026523 |
| 474 | 28.0464 | 0.026634 |
| 475 | 28.0243 | 0.026733 |
| 476 | 27.9912 | 0.026832 |
| 477 | 27.9691 | 0.026987 |
| 478 | 27.9470 | 0.027075 |
| 479 | 27.9139 | 0.027130 |
| 480 | 27.8918 | 0.027230 |
| 481 | 27.8587 | 0.027307 |
| 482 | 27.8366 | 0.027583 |
| 483 | 27.8035 | 0.027693 |
| 484 | 27.7815 | 0.027870 |
| 485 | 27.7483 | 0.028057 |
| 486 | 27.7263 | 0.028212 |
| 487 | 27.6932 | 0.028344 |
| 488 | 27.6711 | 0.028466 |
| 489 | 27.6380 | 0.028609 |
| 490 | 27.6049 | 0.028764 |
| 491 | 27.5828 | 0.028852 |
| 492 | 27.5497 | 0.029007 |
| 493 | 27.5166 | 0.029150 |
| 494 | 27.4945 | 0.029316 |
| 495 | 27.4614 | 0.029492 |
| 496 | 27.4283 | 0.029636 |
| 497 | 27.4062 | 0.029812 |
| 498 | 27.3731 | 0.029945 |
| 499 | 27.3400 | 0.030088 |
| 500 | 27.3179 | 0.030353 |
| 501 | 27.2848 | 0.030497 |
| 502 | 27.2517 | 0.030607 |
| 503 | 27.2185 | 0.030784 |
| 504 | 27.1854 | 0.030949 |
| 505 | 27.1634 | 0.031071 |
| 506 | 27.1302 | 0.031148 |
| 507 | 27.0971 | 0.031280 |
| 508 | 27.0640 | 0.031391 |
| 509 | 27.0309 | 0.031424 |
| 510 | 26.9978 | 0.031534 |
| 511 | 26.9757 | 0.031656 |
| 512 | 26.9426 | 0.031711 |
| 513 | 26.9095 | 0.031810 |
| 514 | 26.8764 | 0.031921 |
| 515 | 26.8433 | 0.031998 |
| 516 | 26.8102 | 0.032031 |
| 517 | 26.7770 | 0.032141 |

Table A-2: Continued
30wt% ZrP in PMMA, 10 C/min

| Temperature (°C) | mass (%) | mass loss rate (%/°C) |
|---|---|---|
| 518 | 26.7439 | 0.032174 |
| 519 | 26.7108 | 0.032174 |
| 520 | 26.6887 | 0.032130 |
| 521 | 26.6556 | 0.032075 |
| 522 | 26.6225 | 0.032064 |
| 523 | 26.5894 | 0.032031 |
| 524 | 26.5563 | 0.031976 |
| 525 | 26.5232 | 0.031909 |
| 526 | 26.4901 | 0.031799 |
| 527 | 26.4570 | 0.031711 |
| 528 | 26.4238 | 0.031611 |
| 529 | 26.3907 | 0.031512 |
| 530 | 26.3687 | 0.031325 |
| 531 | 26.3355 | 0.031082 |
| 532 | 26.3024 | 0.030905 |
| 533 | 26.2693 | 0.030784 |
| 534 | 26.2362 | 0.030530 |
| 535 | 26.2141 | 0.030320 |
| 536 | 26.1810 | 0.030099 |
| 537 | 26.1479 | 0.029845 |
| 538 | 26.1148 | 0.029592 |
| 539 | 26.0927 | 0.029382 |
| 540 | 26.0596 | 0.029117 |
| 541 | 26.0265 | 0.028775 |
| 542 | 26.0044 | 0.028499 |
| 543 | 25.9713 | 0.028267 |
| 544 | 25.9492 | 0.028013 |
| 545 | 25.9161 | 0.027638 |
| 546 | 25.8940 | 0.027329 |
| 547 | 25.8609 | 0.026987 |
| 548 | 25.8389 | 0.026623 |
| 549 | 25.8057 | 0.026313 |
| 550 | 25.7837 | 0.026015 |
| 551 | 25.7616 | 0.025773 |
| 552 | 25.7395 | 0.025762 |
| 553 | 25.7064 | 0.025331 |
| 554 | 25.6843 | 0.024945 |
| 555 | 25.6623 | 0.024283 |
| 556 | 25.6291 | 0.023896 |
| 557 | 25.6071 | 0.023510 |
| 558 | 25.5850 | 0.023113 |
| 559 | 25.5629 | 0.022737 |
| 560 | 25.5408 | 0.022373 |
| 561 | 25.5188 | 0.022108 |
| 562 | 25.4967 | 0.022196 |
| 563 | 25.4746 | 0.021965 |
| 564 | 25.4525 | 0.021733 |
| 565 | 25.4305 | 0.021225 |
| 566 | 25.4084 | 0.020872 |
| 567 | 25.3863 | 0.020762 |
| 568 | 25.3642 | 0.020497 |
| 569 | 25.3532 | 0.020188 |
| 570 | 25.3311 | 0.019702 |
| 571 | 25.3091 | 0.019051 |
| 572 | 25.2870 | 0.018698 |
| 573 | 25.2759 | 0.018444 |
| 574 | 25.2539 | 0.018179 |
| 575 | 25.2428 | 0.017859 |
| 576 | 25.2208 | 0.017605 |
| 577 | 25.1987 | 0.017472 |
| 578 | 25.1766 | 0.017395 |
| 579 | 25.1656 | 0.017252 |
| 580 | 25.1435 | 0.017053 |
| 581 | 25.1325 | 0.016446 |
| 582 | 25.1104 | 0.016148 |
| 583 | 25.0993 | 0.015905 |
| 584 | 25.0883 | 0.015673 |

Table A-2: Continued

30wt% ZrP in PMMA, 10 C/min

| Temperature (°C) | mass (%) | mass loss rate (%/°C) |
|---|---|---|
| 585 | 25.0662 | 0.015375 |
| 586 | 25.0552 | 0.015143 |
| 587 | 25.0442 | 0.014901 |
| 588 | 25.0221 | 0.014702 |
| 589 | 25.0110 | 0.014492 |
| 590 | 25.0000 | 0.014249 |
| 591 | 24.9779 | 0.013974 |
| 592 | 24.9669 | 0.013775 |
| 593 | 24.9558 | 0.013532 |
| 594 | 24.9338 | 0.013267 |
| 595 | 24.9227 | 0.013046 |
| 596 | 24.9117 | 0.012837 |
| 597 | 24.9007 | 0.012616 |
| 598 | 24.8896 | 0.012483 |
| 599 | 24.8786 | 0.012252 |
| 600 | 24.8675 | 0.012020 |
| 601 | 24.8565 | 0.011755 |
| 602 | 24.8344 | 0.011545 |
| 603 | 24.8234 | 0.011347 |
| 604 | 24.8124 | 0.011115 |
| 605 | 24.8013 | 0.010954 |
| 606 | 24.7903 | 0.010798 |
| 607 | 24.7903 | 0.010598 |
| 608 | 24.7792 | 0.010454 |
| 609 | 24.7682 | 0.010235 |
| 610 | 24.7572 | 0.010021 |
| 611 | 24.7461 | 0.009826 |
| 612 | 24.7351 | 0.009640 |
| 613 | 24.7241 | 0.009380 |
| 614 | 24.7130 | 0.009214 |
| 615 | 24.7020 | 0.009132 |
| 616 | 24.6909 | 0.009002 |
| 617 | 24.6909 | 0.008870 |
| 618 | 24.6799 | 0.008706 |
| 619 | 24.6689 | 0.008536 |
| 620 | 24.6578 | 0.008384 |
| 621 | 24.6578 | 0.008269 |
| 622 | 24.6468 | 0.008137 |
| 623 | 24.6358 | 0.007946 |
| 624 | 24.6358 | 0.007722 |
| 625 | 24.6247 | 0.007561 |
| 626 | 24.6137 | 0.007530 |
| 627 | 24.6026 | 0.007440 |
| 628 | 24.6026 | 0.007355 |
| 629 | 24.5916 | 0.007230 |
| 630 | 24.5806 | 0.007105 |
| 631 | 24.5806 | 0.007053 |
| 632 | 24.5695 | 0.006916 |
| 633 | 24.5585 | 0.006788 |
| 634 | 24.5585 | 0.006673 |
| 635 | 24.5475 | 0.006647 |
| 636 | 24.5475 | 0.006783 |
| 637 | 24.5364 | 0.006631 |
| 638 | 24.5254 | 0.006403 |
| 639 | 24.5254 | 0.005921 |
| 640 | 24.5143 | 0.005776 |
| 641 | 24.5143 | 0.005682 |
| 642 | 24.5033 | 0.005602 |
| 643 | 24.5033 | 0.005447 |
| 644 | 24.5033 | 0.005444 |
| 645 | 24.4923 | 0.005494 |
| 646 | 24.4812 | 0.005788 |
| 647 | 24.4812 | 0.005815 |
| 648 | 24.4702 | 0.005802 |
| 649 | 24.4702 | 0.005488 |
| 650 | 24.4592 | 0.005283 |
| 651 | 24.4592 | 0.005158 |

Table A-2: Continued

30wt% ZrP in PMMA, 10 C/min

| Temperature (°C) | mass (%) | mass loss rate (%/°C) |
|---|---|---|
| 652 | 24.4481 | 0.005056 |
| 653 | 24.4481 | 0.004980 |
| 654 | 24.4481 | 0.004895 |
| 655 | 24.4371 | 0.004849 |
| 656 | 24.4371 | 0.004791 |
| 657 | 24.4260 | 0.004754 |
| 658 | 24.4260 | 0.004708 |
| 659 | 24.4150 | 0.004865 |
| 660 | 24.4150 | 0.004715 |
| 661 | 24.4040 | 0.004627 |
| 662 | 24.4040 | 0.004526 |
| 663 | 24.4040 | 0.004373 |
| 664 | 24.3929 | 0.004291 |
| 665 | 24.3929 | 0.004279 |
| 666 | 24.3819 | 0.004173 |
| 667 | 24.3819 | 0.004088 |
| 668 | 24.3819 | 0.004128 |
| 669 | 24.3709 | 0.004156 |
| 670 | 24.3709 | 0.004017 |
| 671 | 24.3709 | 0.003986 |
| 672 | 24.3598 | 0.003999 |
| 673 | 24.3598 | 0.003902 |
| 674 | 24.3598 | 0.003841 |
| 675 | 24.3488 | 0.003862 |
| 676 | 24.3488 | 0.003788 |
| 677 | 24.3488 | 0.003660 |
| 678 | 24.3377 | 0.003648 |
| 679 | 24.3377 | 0.003641 |
| 680 | 24.3377 | 0.003502 |
| 681 | 24.3267 | 0.003412 |
| 682 | 24.3267 | 0.003345 |
| 683 | 24.3267 | 0.003333 |
| 684 | 24.3157 | 0.003316 |
| 685 | 24.3157 | 0.003286 |
| 686 | 24.3157 | 0.003275 |
| 687 | 24.3046 | 0.003183 |
| 688 | 24.3046 | 0.003132 |
| 689 | 24.3046 | 0.003043 |
| 690 | 24.3046 | 0.002983 |
| 691 | 24.2936 | 0.002933 |
| 692 | 24.2936 | 0.002841 |
| 693 | 24.2936 | 0.002815 |
| 694 | 24.2936 | 0.002773 |
| 695 | 24.2826 | 0.002733 |
| 696 | 24.2826 | 0.002805 |
| 697 | 24.2826 | 0.002730 |
| 698 | 24.2826 | 0.002638 |
| 699 | 24.2715 | 0.002563 |
| 700 | 24.2715 | 0.002492 |

Table A-3: UV-vis Spectroscopy Data for PMMA and 5wt% ZrP in PMMA

| PMMA | | | 5wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 900.00 | 0.00 | 100.46 | 900.00 | -0.01 | 103.04 |
| 899.00 | 0.01 | 98.86 | 899.00 | 0.00 | 100.46 |
| 898.00 | 0.03 | 93.97 | 898.00 | 0.02 | 96.38 |
| 897.00 | 0.04 | 91.41 | 897.00 | 0.03 | 93.97 |
| 896.00 | 0.05 | 90.16 | 896.00 | 0.04 | 92.04 |
| 895.00 | 0.04 | 90.57 | 895.00 | 0.04 | 91.83 |
| 894.00 | 0.04 | 92.04 | 894.00 | 0.03 | 93.11 |
| 893.00 | 0.03 | 93.33 | 893.00 | 0.03 | 92.68 |
| 892.00 | 0.03 | 92.47 | 892.00 | 0.04 | 91.20 |
| 891.00 | 0.04 | 91.83 | 891.00 | 0.04 | 90.57 |
| 890.00 | 0.03 | 94.41 | 890.00 | 0.04 | 90.36 |
| 889.00 | 0.02 | 95.06 | 889.00 | 0.05 | 89.95 |
| 888.00 | 0.02 | 94.84 | 888.00 | 0.05 | 89.13 |
| 887.00 | 0.04 | 92.04 | 887.00 | 0.05 | 89.33 |
| 886.00 | 0.04 | 91.83 | 886.00 | 0.04 | 90.36 |
| 885.00 | 0.03 | 93.33 | 885.00 | 0.03 | 92.90 |
| 884.00 | 0.04 | 90.99 | 884.00 | 0.03 | 93.11 |
| 883.00 | 0.04 | 90.99 | 883.00 | 0.03 | 93.76 |
| 882.00 | 0.04 | 91.62 | 882.00 | 0.03 | 93.11 |
| 881.00 | 0.03 | 92.68 | 881.00 | 0.03 | 92.68 |
| 880.00 | 0.03 | 94.19 | 880.00 | 0.03 | 93.76 |
| 879.00 | 0.02 | 95.50 | 879.00 | 0.03 | 94.19 |
| 878.00 | 0.02 | 95.72 | 878.00 | 0.03 | 93.97 |
| 877.00 | 0.03 | 93.97 | 877.00 | 0.03 | 93.11 |
| 876.00 | 0.03 | 92.90 | 876.00 | 0.04 | 91.83 |
| 875.00 | 0.04 | 91.62 | 875.00 | 0.04 | 91.62 |
| 874.00 | 0.04 | 91.62 | 874.00 | 0.04 | 90.78 |
| 873.00 | 0.04 | 90.99 | 873.00 | 0.04 | 90.36 |
| 872.00 | 0.04 | 91.83 | 872.00 | 0.05 | 89.74 |
| 871.00 | 0.03 | 93.76 | 871.00 | 0.04 | 90.99 |
| 870.00 | 0.03 | 94.19 | 870.00 | 0.04 | 92.26 |
| 869.00 | 0.03 | 93.97 | 869.00 | 0.03 | 93.33 |
| 868.00 | 0.03 | 93.76 | 868.00 | 0.03 | 93.97 |
| 867.00 | 0.03 | 92.90 | 867.00 | 0.03 | 93.54 |
| 866.00 | 0.04 | 92.26 | 866.00 | 0.03 | 92.68 |
| 865.00 | 0.04 | 92.04 | 865.00 | 0.03 | 92.47 |
| 864.00 | 0.04 | 91.83 | 864.00 | 0.04 | 92.26 |
| 863.00 | 0.04 | 91.20 | 863.00 | 0.04 | 91.83 |
| 862.00 | 0.04 | 90.99 | 862.00 | 0.04 | 91.41 |
| 861.00 | 0.04 | 90.99 | 861.00 | 0.04 | 91.41 |
| 860.00 | 0.04 | 90.99 | 860.00 | 0.04 | 91.62 |
| 859.00 | 0.04 | 91.20 | 859.00 | 0.04 | 92.04 |
| 858.00 | 0.04 | 90.99 | 858.00 | 0.04 | 91.62 |
| 857.00 | 0.04 | 91.83 | 857.00 | 0.04 | 91.83 |
| 856.00 | 0.03 | 92.47 | 856.00 | 0.04 | 92.04 |
| 855.00 | 0.03 | 92.90 | 855.00 | 0.03 | 92.47 |
| 854.00 | 0.03 | 92.90 | 854.00 | 0.04 | 92.26 |
| 853.00 | 0.04 | 92.26 | 853.00 | 0.04 | 91.83 |
| 852.00 | 0.04 | 92.04 | 852.00 | 0.04 | 91.62 |
| 851.00 | 0.04 | 91.62 | 851.00 | 0.04 | 91.62 |
| 850.00 | 0.04 | 91.83 | 850.00 | 0.04 | 91.62 |
| 849.00 | 0.04 | 91.41 | 849.00 | 0.04 | 91.62 |
| 848.00 | 0.04 | 91.20 | 848.00 | 0.04 | 91.83 |
| 847.00 | 0.04 | 91.41 | 847.00 | 0.04 | 92.04 |
| 846.00 | 0.04 | 91.41 | 846.00 | 0.04 | 91.83 |
| 845.00 | 0.04 | 91.62 | 845.00 | 0.04 | 92.04 |
| 844.00 | 0.04 | 91.41 | 844.00 | 0.04 | 91.62 |
| 843.00 | 0.04 | 91.62 | 843.00 | 0.04 | 91.62 |
| 842.00 | 0.04 | 91.83 | 842.00 | 0.04 | 91.62 |
| 841.00 | 0.04 | 91.83 | 841.00 | 0.04 | 91.83 |
| 840.00 | 0.04 | 91.62 | 840.00 | 0.04 | 91.62 |
| 839.00 | 0.04 | 91.20 | 839.00 | 0.04 | 91.41 |
| 838.00 | 0.04 | 91.41 | 838.00 | 0.04 | 91.62 |
| 837.00 | 0.04 | 91.20 | 837.00 | 0.04 | 91.83 |
| 836.00 | 0.04 | 91.20 | 836.00 | 0.04 | 91.83 |
| 835.00 | 0.04 | 91.41 | 835.00 | 0.04 | 91.62 |
| 834.00 | 0.04 | 91.41 | 834.00 | 0.04 | 91.62 |

Table A-3: Continued

| | PMMA | | | 5wt% ZrP in PMMA | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 833.00 | 0.04 | 91.62 | 833.00 | 0.04 | 91.62 |
| 832.00 | 0.04 | 91.62 | 832.00 | 0.04 | 91.62 |
| 831.00 | 0.04 | 91.41 | 831.00 | 0.04 | 91.62 |
| 830.00 | 0.04 | 91.20 | 830.00 | 0.04 | 91.41 |
| 829.00 | 0.04 | 90.99 | 829.00 | 0.04 | 91.41 |
| 828.00 | 0.04 | 90.99 | 828.00 | 0.04 | 91.20 |
| 827.00 | 0.04 | 90.99 | 827.00 | 0.04 | 91.20 |
| 826.00 | 0.04 | 91.20 | 826.00 | 0.04 | 91.41 |
| 825.00 | 0.04 | 91.41 | 825.00 | 0.04 | 91.62 |
| 824.00 | 0.04 | 91.41 | 824.00 | 0.04 | 91.62 |
| 823.00 | 0.04 | 91.62 | 823.00 | 0.04 | 91.83 |
| 822.00 | 0.04 | 91.62 | 822.00 | 0.04 | 91.83 |
| 821.00 | 0.04 | 91.41 | 821.00 | 0.04 | 91.83 |
| 820.00 | 0.04 | 91.41 | 820.00 | 0.04 | 91.83 |
| 819.00 | 0.04 | 91.41 | 819.00 | 0.04 | 91.62 |
| 818.00 | 0.04 | 91.62 | 818.00 | 0.04 | 91.62 |
| 817.00 | 0.04 | 91.41 | 817.00 | 0.04 | 91.41 |
| 816.00 | 0.04 | 91.41 | 816.00 | 0.04 | 91.41 |
| 815.00 | 0.04 | 91.41 | 815.00 | 0.04 | 91.41 |
| 814.00 | 0.04 | 91.62 | 814.00 | 0.04 | 91.41 |
| 813.00 | 0.04 | 91.41 | 813.00 | 0.04 | 91.41 |
| 812.00 | 0.04 | 91.41 | 812.00 | 0.04 | 91.41 |
| 811.00 | 0.04 | 91.41 | 811.00 | 0.04 | 91.62 |
| 810.00 | 0.04 | 91.41 | 810.00 | 0.04 | 91.41 |
| 809.00 | 0.04 | 91.20 | 809.00 | 0.04 | 91.41 |
| 808.00 | 0.04 | 91.41 | 808.00 | 0.04 | 91.41 |
| 807.00 | 0.04 | 91.41 | 807.00 | 0.04 | 91.62 |
| 806.00 | 0.04 | 91.41 | 806.00 | 0.04 | 91.62 |
| 805.00 | 0.04 | 91.41 | 805.00 | 0.04 | 91.62 |
| 804.00 | 0.04 | 91.62 | 804.00 | 0.04 | 91.83 |
| 803.00 | 0.04 | 91.62 | 803.00 | 0.04 | 91.83 |
| 802.00 | 0.04 | 91.62 | 802.00 | 0.04 | 91.62 |
| 801.00 | 0.04 | 91.41 | 801.00 | 0.04 | 91.41 |
| 800.00 | 0.04 | 91.41 | 800.00 | 0.04 | 91.41 |
| 799.00 | 0.04 | 91.41 | 799.00 | 0.04 | 91.62 |
| 798.00 | 0.04 | 91.41 | 798.00 | 0.04 | 91.62 |
| 797.00 | 0.04 | 91.41 | 797.00 | 0.04 | 91.83 |
| 796.00 | 0.04 | 91.41 | 796.00 | 0.04 | 91.83 |
| 795.00 | 0.04 | 91.41 | 795.00 | 0.04 | 91.83 |
| 794.00 | 0.04 | 91.41 | 794.00 | 0.04 | 91.62 |
| 793.00 | 0.04 | 91.41 | 793.00 | 0.04 | 91.41 |
| 792.00 | 0.04 | 91.41 | 792.00 | 0.04 | 91.20 |
| 791.00 | 0.04 | 91.41 | 791.00 | 0.04 | 91.20 |
| 790.00 | 0.04 | 91.62 | 790.00 | 0.04 | 91.41 |
| 789.00 | 0.04 | 91.62 | 789.00 | 0.04 | 91.41 |
| 788.00 | 0.04 | 91.62 | 788.00 | 0.04 | 91.41 |
| 787.00 | 0.04 | 91.41 | 787.00 | 0.04 | 91.41 |
| 786.00 | 0.04 | 91.20 | 786.00 | 0.04 | 91.41 |
| 785.00 | 0.04 | 91.20 | 785.00 | 0.04 | 91.41 |
| 784.00 | 0.04 | 91.20 | 784.00 | 0.04 | 91.41 |
| 783.00 | 0.04 | 91.41 | 783.00 | 0.04 | 91.41 |
| 782.00 | 0.04 | 91.41 | 782.00 | 0.04 | 91.41 |
| 781.00 | 0.04 | 91.62 | 781.00 | 0.04 | 91.62 |
| 780.00 | 0.04 | 91.41 | 780.00 | 0.04 | 91.62 |
| 779.00 | 0.04 | 91.41 | 779.00 | 0.04 | 91.62 |
| 778.00 | 0.04 | 91.41 | 778.00 | 0.04 | 91.62 |
| 777.00 | 0.04 | 91.41 | 777.00 | 0.04 | 91.83 |
| 776.00 | 0.04 | 91.41 | 776.00 | 0.04 | 91.83 |
| 775.00 | 0.04 | 91.41 | 775.00 | 0.04 | 91.83 |
| 774.00 | 0.04 | 91.62 | 774.00 | 0.04 | 91.62 |
| 773.00 | 0.04 | 91.41 | 773.00 | 0.04 | 91.41 |
| 772.00 | 0.04 | 91.62 | 772.00 | 0.04 | 91.41 |
| 771.00 | 0.04 | 91.62 | 771.00 | 0.04 | 91.41 |
| 770.00 | 0.04 | 91.62 | 770.00 | 0.04 | 91.41 |

Table A-3: Continued

| | PMMA | | | 5wt% ZrP in PMMA | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 769.00 | 0.04 | 91.62 | 769.00 | 0.04 | 91.41 |
| 768.00 | 0.04 | 91.62 | 768.00 | 0.04 | 91.41 |
| 767.00 | 0.04 | 91.62 | 767.00 | 0.04 | 91.41 |
| 766.00 | 0.04 | 91.41 | 766.00 | 0.04 | 91.41 |
| 765.00 | 0.04 | 91.41 | 765.00 | 0.04 | 91.20 |
| 764.00 | 0.04 | 91.41 | 764.00 | 0.04 | 91.41 |
| 763.00 | 0.04 | 91.41 | 763.00 | 0.04 | 91.41 |
| 762.00 | 0.04 | 91.41 | 762.00 | 0.04 | 91.41 |
| 761.00 | 0.04 | 91.41 | 761.00 | 0.04 | 91.41 |
| 760.00 | 0.04 | 91.41 | 760.00 | 0.04 | 91.41 |
| 759.00 | 0.04 | 91.41 | 759.00 | 0.04 | 91.62 |
| 758.00 | 0.04 | 91.62 | 758.00 | 0.04 | 91.62 |
| 757.00 | 0.04 | 91.41 | 757.00 | 0.04 | 91.62 |
| 756.00 | 0.04 | 91.41 | 756.00 | 0.04 | 91.41 |
| 755.00 | 0.04 | 91.20 | 755.00 | 0.04 | 91.41 |
| 754.00 | 0.04 | 91.20 | 754.00 | 0.04 | 91.20 |
| 753.00 | 0.04 | 91.20 | 753.00 | 0.04 | 91.20 |
| 752.00 | 0.04 | 91.20 | 752.00 | 0.04 | 91.20 |
| 751.00 | 0.04 | 91.20 | 751.00 | 0.04 | 91.20 |
| 750.00 | 0.04 | 91.41 | 750.00 | 0.04 | 91.20 |
| 749.00 | 0.04 | 91.41 | 749.00 | 0.04 | 91.41 |
| 748.00 | 0.04 | 91.41 | 748.00 | 0.04 | 91.41 |
| 747.00 | 0.04 | 91.62 | 747.00 | 0.04 | 91.62 |
| 746.00 | 0.04 | 91.62 | 746.00 | 0.04 | 91.62 |
| 745.00 | 0.04 | 91.62 | 745.00 | 0.04 | 91.62 |
| 744.00 | 0.04 | 91.41 | 744.00 | 0.04 | 91.62 |
| 743.00 | 0.04 | 91.41 | 743.00 | 0.04 | 91.41 |
| 742.00 | 0.04 | 91.62 | 742.00 | 0.04 | 91.41 |
| 741.00 | 0.04 | 91.41 | 741.00 | 0.04 | 91.41 |
| 740.00 | 0.04 | 91.62 | 740.00 | 0.04 | 91.41 |
| 739.00 | 0.04 | 91.62 | 739.00 | 0.04 | 91.41 |
| 738.00 | 0.04 | 91.41 | 738.00 | 0.04 | 91.41 |
| 737.00 | 0.04 | 91.41 | 737.00 | 0.04 | 91.41 |
| 736.00 | 0.04 | 91.41 | 736.00 | 0.04 | 91.62 |
| 735.00 | 0.04 | 91.41 | 735.00 | 0.04 | 91.62 |
| 734.00 | 0.04 | 91.41 | 734.00 | 0.04 | 91.62 |
| 733.00 | 0.04 | 91.20 | 733.00 | 0.04 | 91.41 |
| 732.00 | 0.04 | 91.41 | 732.00 | 0.04 | 91.41 |
| 731.00 | 0.04 | 91.41 | 731.00 | 0.04 | 91.41 |
| 730.00 | 0.04 | 91.41 | 730.00 | 0.04 | 91.41 |
| 729.00 | 0.04 | 91.41 | 729.00 | 0.04 | 91.41 |
| 728.00 | 0.04 | 91.41 | 728.00 | 0.04 | 91.62 |
| 727.00 | 0.04 | 91.41 | 727.00 | 0.04 | 91.62 |
| 726.00 | 0.04 | 91.41 | 726.00 | 0.04 | 91.62 |
| 725.00 | 0.04 | 91.41 | 725.00 | 0.04 | 91.62 |
| 724.00 | 0.04 | 91.20 | 724.00 | 0.04 | 91.41 |
| 723.00 | 0.04 | 91.20 | 723.00 | 0.04 | 91.41 |
| 722.00 | 0.04 | 91.20 | 722.00 | 0.04 | 91.20 |
| 721.00 | 0.04 | 91.20 | 721.00 | 0.04 | 91.20 |
| 720.00 | 0.04 | 91.41 | 720.00 | 0.04 | 91.41 |
| 719.00 | 0.04 | 91.20 | 719.00 | 0.04 | 91.41 |
| 718.00 | 0.04 | 91.41 | 718.00 | 0.04 | 91.41 |
| 717.00 | 0.04 | 91.41 | 717.00 | 0.04 | 91.41 |
| 716.00 | 0.04 | 91.41 | 716.00 | 0.04 | 91.41 |
| 715.00 | 0.04 | 91.41 | 715.00 | 0.04 | 91.41 |
| 714.00 | 0.04 | 91.41 | 714.00 | 0.04 | 91.62 |
| 713.00 | 0.04 | 91.41 | 713.00 | 0.04 | 91.41 |
| 712.00 | 0.04 | 91.41 | 712.00 | 0.04 | 91.41 |
| 711.00 | 0.04 | 91.41 | 711.00 | 0.04 | 91.41 |
| 710.00 | 0.04 | 91.41 | 710.00 | 0.04 | 91.41 |
| 709.00 | 0.04 | 91.41 | 709.00 | 0.04 | 91.41 |
| 708.00 | 0.04 | 91.41 | 708.00 | 0.04 | 91.41 |
| 707.00 | 0.04 | 91.41 | 707.00 | 0.04 | 91.62 |
| 706.00 | 0.04 | 91.41 | 706.00 | 0.04 | 91.62 |

Table A-3: Continued

| PMMA | | | 5wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 705.00 | 0.04 | 91.41 | 705.00 | 0.04 | 91.62 |
| 704.00 | 0.04 | 91.41 | 704.00 | 0.04 | 91.62 |
| 703.00 | 0.04 | 91.41 | 703.00 | 0.04 | 91.62 |
| 702.00 | 0.04 | 91.41 | 702.00 | 0.04 | 91.62 |
| 701.00 | 0.04 | 91.41 | 701.00 | 0.04 | 91.41 |
| 700.00 | 0.04 | 91.41 | 700.00 | 0.04 | 91.41 |
| 699.00 | 0.04 | 91.41 | 699.00 | 0.04 | 91.41 |
| 698.00 | 0.04 | 91.20 | 698.00 | 0.04 | 91.41 |
| 697.00 | 0.04 | 91.41 | 697.00 | 0.04 | 91.41 |
| 696.00 | 0.04 | 91.41 | 696.00 | 0.04 | 91.41 |
| 695.00 | 0.04 | 91.41 | 695.00 | 0.04 | 91.41 |
| 694.00 | 0.04 | 91.41 | 694.00 | 0.04 | 91.62 |
| 693.00 | 0.04 | 91.41 | 693.00 | 0.04 | 91.62 |
| 692.00 | 0.04 | 91.41 | 692.00 | 0.04 | 91.41 |
| 691.00 | 0.04 | 91.41 | 691.00 | 0.04 | 91.41 |
| 690.00 | 0.04 | 91.20 | 690.00 | 0.04 | 91.41 |
| 689.00 | 0.04 | 91.41 | 689.00 | 0.04 | 91.41 |
| 688.00 | 0.04 | 91.41 | 688.00 | 0.04 | 91.41 |
| 687.00 | 0.04 | 91.41 | 687.00 | 0.04 | 91.41 |
| 686.00 | 0.04 | 91.20 | 686.00 | 0.04 | 91.41 |
| 685.00 | 0.04 | 91.20 | 685.00 | 0.04 | 91.41 |
| 684.00 | 0.04 | 91.20 | 684.00 | 0.04 | 91.41 |
| 683.00 | 0.04 | 91.41 | 683.00 | 0.04 | 91.41 |
| 682.00 | 0.04 | 91.41 | 682.00 | 0.04 | 91.62 |
| 681.00 | 0.04 | 91.41 | 681.00 | 0.04 | 91.62 |
| 680.00 | 0.04 | 91.41 | 680.00 | 0.04 | 91.62 |
| 679.00 | 0.04 | 91.41 | 679.00 | 0.04 | 91.62 |
| 678.00 | 0.04 | 91.20 | 678.00 | 0.04 | 91.41 |
| 677.00 | 0.04 | 91.20 | 677.00 | 0.04 | 91.41 |
| 676.00 | 0.04 | 91.20 | 676.00 | 0.04 | 91.41 |
| 675.00 | 0.04 | 91.20 | 675.00 | 0.04 | 91.20 |
| 674.00 | 0.04 | 91.41 | 674.00 | 0.04 | 91.41 |
| 673.00 | 0.04 | 91.41 | 673.00 | 0.04 | 91.41 |
| 672.00 | 0.04 | 91.41 | 672.00 | 0.04 | 91.41 |
| 671.00 | 0.04 | 91.41 | 671.00 | 0.04 | 91.41 |
| 670.00 | 0.04 | 91.20 | 670.00 | 0.04 | 91.41 |
| 669.00 | 0.04 | 91.20 | 669.00 | 0.04 | 91.41 |
| 668.00 | 0.04 | 91.20 | 668.00 | 0.04 | 91.41 |
| 667.00 | 0.04 | 91.20 | 667.00 | 0.04 | 91.20 |
| 666.00 | 0.04 | 91.20 | 666.00 | 0.04 | 91.20 |
| 665.00 | 0.04 | 91.20 | 665.00 | 0.04 | 91.20 |
| 664.00 | 0.04 | 91.20 | 664.00 | 0.04 | 91.41 |
| 663.00 | 0.04 | 91.41 | 663.00 | 0.04 | 91.41 |
| 662.00 | 0.04 | 91.41 | 662.00 | 0.04 | 91.41 |
| 661.00 | 0.04 | 91.41 | 661.00 | 0.04 | 91.41 |
| 660.00 | 0.04 | 91.41 | 660.00 | 0.04 | 91.41 |
| 659.00 | 0.04 | 91.41 | 659.00 | 0.04 | 91.41 |
| 658.00 | 0.04 | 91.41 | 658.00 | 0.04 | 91.41 |
| 657.00 | 0.04 | 91.41 | 657.00 | 0.04 | 91.41 |
| 656.00 | 0.04 | 91.20 | 656.00 | 0.04 | 91.41 |
| 655.00 | 0.04 | 91.20 | 655.00 | 0.04 | 91.20 |
| 654.00 | 0.04 | 91.20 | 654.00 | 0.04 | 91.41 |
| 653.00 | 0.04 | 91.20 | 653.00 | 0.04 | 91.20 |
| 652.00 | 0.04 | 91.20 | 652.00 | 0.04 | 91.20 |
| 651.00 | 0.04 | 91.20 | 651.00 | 0.04 | 91.20 |
| 650.00 | 0.04 | 91.20 | 650.00 | 0.04 | 91.20 |
| 649.00 | 0.04 | 91.20 | 649.00 | 0.04 | 91.41 |
| 648.00 | 0.04 | 91.20 | 648.00 | 0.04 | 91.41 |
| 647.00 | 0.04 | 91.20 | 647.00 | 0.04 | 91.41 |
| 646.00 | 0.04 | 91.20 | 646.00 | 0.04 | 91.41 |
| 645.00 | 0.04 | 91.41 | 645.00 | 0.04 | 91.41 |
| 644.00 | 0.04 | 91.41 | 644.00 | 0.04 | 91.41 |
| 643.00 | 0.04 | 91.62 | 643.00 | 0.04 | 91.41 |
| 642.00 | 0.04 | 91.41 | 642.00 | 0.04 | 91.41 |

Table A-3: Continued

| PMMA | | | 5wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 641.00 | 0.04 | 91.41 | 641.00 | 0.04 | 91.41 |
| 640.00 | 0.04 | 91.41 | 640.00 | 0.04 | 91.62 |
| 639.00 | 0.04 | 91.20 | 639.00 | 0.04 | 91.41 |
| 638.00 | 0.04 | 91.20 | 638.00 | 0.04 | 91.41 |
| 637.00 | 0.04 | 91.20 | 637.00 | 0.04 | 91.41 |
| 636.00 | 0.04 | 91.20 | 636.00 | 0.04 | 91.20 |
| 635.00 | 0.04 | 91.20 | 635.00 | 0.04 | 91.20 |
| 634.00 | 0.04 | 91.41 | 634.00 | 0.04 | 91.20 |
| 633.00 | 0.04 | 91.20 | 633.00 | 0.04 | 91.20 |
| 632.00 | 0.04 | 91.20 | 632.00 | 0.04 | 91.20 |
| 631.00 | 0.04 | 91.20 | 631.00 | 0.04 | 91.41 |
| 630.00 | 0.04 | 91.20 | 630.00 | 0.04 | 91.20 |
| 629.00 | 0.04 | 91.20 | 629.00 | 0.04 | 91.20 |
| 628.00 | 0.04 | 91.20 | 628.00 | 0.04 | 91.41 |
| 627.00 | 0.04 | 91.20 | 627.00 | 0.04 | 91.20 |
| 626.00 | 0.04 | 91.41 | 626.00 | 0.04 | 91.41 |
| 625.00 | 0.04 | 91.41 | 625.00 | 0.04 | 91.41 |
| 624.00 | 0.04 | 91.20 | 624.00 | 0.04 | 91.41 |
| 623.00 | 0.04 | 91.20 | 623.00 | 0.04 | 91.41 |
| 622.00 | 0.04 | 91.20 | 622.00 | 0.04 | 91.41 |
| 621.00 | 0.04 | 91.20 | 621.00 | 0.04 | 91.20 |
| 620.00 | 0.04 | 91.20 | 620.00 | 0.04 | 91.20 |
| 619.00 | 0.04 | 91.20 | 619.00 | 0.04 | 91.20 |
| 618.00 | 0.04 | 91.20 | 618.00 | 0.04 | 91.20 |
| 617.00 | 0.04 | 91.20 | 617.00 | 0.04 | 91.20 |
| 616.00 | 0.04 | 91.20 | 616.00 | 0.04 | 91.20 |
| 615.00 | 0.04 | 91.41 | 615.00 | 0.04 | 91.41 |
| 614.00 | 0.04 | 91.41 | 614.00 | 0.04 | 91.41 |
| 613.00 | 0.04 | 91.20 | 613.00 | 0.04 | 91.41 |
| 612.00 | 0.04 | 91.41 | 612.00 | 0.04 | 91.41 |
| 611.00 | 0.04 | 91.20 | 611.00 | 0.04 | 91.41 |
| 610.00 | 0.04 | 91.20 | 610.00 | 0.04 | 91.41 |
| 609.00 | 0.04 | 91.20 | 609.00 | 0.04 | 91.41 |
| 608.00 | 0.04 | 91.20 | 608.00 | 0.04 | 91.41 |
| 607.00 | 0.04 | 91.20 | 607.00 | 0.04 | 91.20 |
| 606.00 | 0.04 | 91.41 | 606.00 | 0.04 | 91.41 |
| 605.00 | 0.04 | 91.41 | 605.00 | 0.04 | 91.20 |
| 604.00 | 0.04 | 91.20 | 604.00 | 0.04 | 91.20 |
| 603.00 | 0.04 | 91.20 | 603.00 | 0.04 | 91.20 |
| 602.00 | 0.04 | 91.20 | 602.00 | 0.04 | 91.20 |
| 601.00 | 0.04 | 91.20 | 601.00 | 0.04 | 91.20 |
| 600.00 | 0.04 | 91.20 | 600.00 | 0.04 | 91.20 |
| 599.00 | 0.04 | 91.20 | 599.00 | 0.04 | 91.41 |
| 598.00 | 0.04 | 91.20 | 598.00 | 0.04 | 91.20 |
| 597.00 | 0.04 | 91.20 | 597.00 | 0.04 | 91.20 |
| 596.00 | 0.04 | 91.20 | 596.00 | 0.04 | 91.20 |
| 595.00 | 0.04 | 91.20 | 595.00 | 0.04 | 91.41 |
| 594.00 | 0.04 | 91.20 | 594.00 | 0.04 | 91.20 |
| 593.00 | 0.04 | 91.20 | 593.00 | 0.04 | 91.20 |
| 592.00 | 0.04 | 91.20 | 592.00 | 0.04 | 91.20 |
| 591.00 | 0.04 | 91.20 | 591.00 | 0.04 | 91.20 |
| 590.00 | 0.04 | 91.20 | 590.00 | 0.04 | 90.99 |
| 589.00 | 0.04 | 91.20 | 589.00 | 0.04 | 90.99 |
| 588.00 | 0.04 | 91.20 | 588.00 | 0.04 | 91.20 |
| 587.00 | 0.04 | 91.20 | 587.00 | 0.04 | 91.20 |
| 586.00 | 0.04 | 91.20 | 586.00 | 0.04 | 91.20 |
| 585.00 | 0.04 | 91.20 | 585.00 | 0.04 | 91.20 |
| 584.00 | 0.04 | 91.20 | 584.00 | 0.04 | 91.20 |
| 583.00 | 0.04 | 91.20 | 583.00 | 0.04 | 91.20 |
| 582.00 | 0.04 | 91.20 | 582.00 | 0.04 | 91.20 |
| 581.00 | 0.04 | 91.20 | 581.00 | 0.04 | 91.20 |
| 580.00 | 0.04 | 91.20 | 580.00 | 0.04 | 91.20 |
| 579.00 | 0.04 | 91.20 | 579.00 | 0.04 | 91.20 |
| 578.00 | 0.04 | 91.20 | 578.00 | 0.04 | 91.20 |

Table A-3: Continued

| | PMMA | | | 5wt% ZrP in PMMA | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 577.00 | 0.04 | 91.20 | 577.00 | 0.04 | 91.20 |
| 576.00 | 0.04 | 91.20 | 576.00 | 0.04 | 91.20 |
| 575.00 | 0.04 | 91.20 | 575.00 | 0.04 | 91.20 |
| 574.00 | 0.04 | 91.20 | 574.00 | 0.04 | 91.20 |
| 573.00 | 0.04 | 91.20 | 573.00 | 0.04 | 91.20 |
| 572.00 | 0.04 | 91.20 | 572.00 | 0.04 | 91.20 |
| 571.00 | 0.04 | 91.20 | 571.00 | 0.04 | 91.20 |
| 570.00 | 0.04 | 91.20 | 570.00 | 0.04 | 91.20 |
| 569.00 | 0.04 | 91.20 | 569.00 | 0.04 | 90.99 |
| 568.00 | 0.04 | 91.20 | 568.00 | 0.04 | 90.99 |
| 567.00 | 0.04 | 91.20 | 567.00 | 0.04 | 91.20 |
| 566.00 | 0.04 | 91.20 | 566.00 | 0.04 | 91.20 |
| 565.00 | 0.04 | 91.20 | 565.00 | 0.04 | 91.20 |
| 564.00 | 0.04 | 91.20 | 564.00 | 0.04 | 91.20 |
| 563.00 | 0.04 | 91.20 | 563.00 | 0.04 | 91.20 |
| 562.00 | 0.04 | 91.20 | 562.00 | 0.04 | 91.20 |
| 561.00 | 0.04 | 91.20 | 561.00 | 0.04 | 91.20 |
| 560.00 | 0.04 | 91.20 | 560.00 | 0.04 | 91.20 |
| 559.00 | 0.04 | 91.20 | 559.00 | 0.04 | 91.20 |
| 558.00 | 0.04 | 91.20 | 558.00 | 0.04 | 91.20 |
| 557.00 | 0.04 | 91.20 | 557.00 | 0.04 | 91.20 |
| 556.00 | 0.04 | 91.20 | 556.00 | 0.04 | 91.20 |
| 555.00 | 0.04 | 91.20 | 555.00 | 0.04 | 91.20 |
| 554.00 | 0.04 | 91.20 | 554.00 | 0.04 | 91.20 |
| 553.00 | 0.04 | 91.20 | 553.00 | 0.04 | 91.20 |
| 552.00 | 0.04 | 91.20 | 552.00 | 0.04 | 91.20 |
| 551.00 | 0.04 | 91.20 | 551.00 | 0.04 | 91.20 |
| 550.00 | 0.04 | 91.20 | 550.00 | 0.04 | 91.20 |
| 549.00 | 0.04 | 91.20 | 549.00 | 0.04 | 91.20 |
| 548.00 | 0.04 | 91.20 | 548.00 | 0.04 | 91.20 |
| 547.00 | 0.04 | 91.20 | 547.00 | 0.04 | 91.20 |
| 546.00 | 0.04 | 91.20 | 546.00 | 0.04 | 91.20 |
| 545.00 | 0.04 | 91.20 | 545.00 | 0.04 | 91.20 |
| 544.00 | 0.04 | 91.20 | 544.00 | 0.04 | 91.20 |
| 543.00 | 0.04 | 91.20 | 543.00 | 0.04 | 91.20 |
| 542.00 | 0.04 | 90.99 | 542.00 | 0.04 | 91.20 |
| 541.00 | 0.04 | 91.20 | 541.00 | 0.04 | 91.20 |
| 540.00 | 0.04 | 91.20 | 540.00 | 0.04 | 91.20 |
| 539.00 | 0.04 | 91.20 | 539.00 | 0.04 | 91.20 |
| 538.00 | 0.04 | 91.20 | 538.00 | 0.04 | 91.20 |
| 537.00 | 0.04 | 91.20 | 537.00 | 0.04 | 91.20 |
| 536.00 | 0.04 | 91.20 | 536.00 | 0.04 | 91.20 |
| 535.00 | 0.04 | 90.99 | 535.00 | 0.04 | 91.20 |
| 534.00 | 0.04 | 91.20 | 534.00 | 0.04 | 91.20 |
| 533.00 | 0.04 | 91.20 | 533.00 | 0.04 | 91.20 |
| 532.00 | 0.04 | 91.20 | 532.00 | 0.04 | 91.20 |
| 531.00 | 0.04 | 91.20 | 531.00 | 0.04 | 91.20 |
| 530.00 | 0.04 | 91.20 | 530.00 | 0.04 | 91.20 |
| 529.00 | 0.04 | 91.20 | 529.00 | 0.04 | 91.20 |
| 528.00 | 0.04 | 91.20 | 528.00 | 0.04 | 91.20 |
| 527.00 | 0.04 | 90.99 | 527.00 | 0.04 | 90.99 |
| 526.00 | 0.04 | 90.99 | 526.00 | 0.04 | 90.99 |
| 525.00 | 0.04 | 90.99 | 525.00 | 0.04 | 90.99 |
| 524.00 | 0.04 | 90.99 | 524.00 | 0.04 | 90.99 |
| 523.00 | 0.04 | 90.99 | 523.00 | 0.04 | 90.99 |
| 522.00 | 0.04 | 90.99 | 522.00 | 0.04 | 90.99 |
| 521.00 | 0.04 | 90.99 | 521.00 | 0.04 | 90.99 |
| 520.00 | 0.04 | 90.99 | 520.00 | 0.04 | 90.99 |
| 519.00 | 0.04 | 90.99 | 519.00 | 0.04 | 91.20 |
| 518.00 | 0.04 | 90.99 | 518.00 | 0.04 | 91.20 |
| 517.00 | 0.04 | 90.99 | 517.00 | 0.04 | 91.20 |
| 516.00 | 0.04 | 90.99 | 516.00 | 0.04 | 90.99 |
| 515.00 | 0.04 | 90.99 | 515.00 | 0.04 | 91.20 |
| 514.00 | 0.04 | 91.20 | 514.00 | 0.04 | 91.20 |

Table A-3: Continued

| PMMA | | | 5wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 513.00 | 0.04 | 91.20 | 513.00 | 0.04 | 91.20 |
| 512.00 | 0.04 | 91.20 | 512.00 | 0.04 | 91.20 |
| 511.00 | 0.04 | 91.20 | 511.00 | 0.04 | 91.20 |
| 510.00 | 0.04 | 91.20 | 510.00 | 0.04 | 91.20 |
| 509.00 | 0.04 | 91.20 | 509.00 | 0.04 | 91.20 |
| 508.00 | 0.04 | 91.20 | 508.00 | 0.04 | 91.20 |
| 507.00 | 0.04 | 90.99 | 507.00 | 0.04 | 90.99 |
| 506.00 | 0.04 | 90.99 | 506.00 | 0.04 | 90.99 |
| 505.00 | 0.04 | 90.99 | 505.00 | 0.04 | 90.99 |
| 504.00 | 0.04 | 90.99 | 504.00 | 0.04 | 90.99 |
| 503.00 | 0.04 | 90.99 | 503.00 | 0.04 | 90.99 |
| 502.00 | 0.04 | 90.99 | 502.00 | 0.04 | 90.99 |
| 501.00 | 0.04 | 90.99 | 501.00 | 0.04 | 90.99 |
| 500.00 | 0.04 | 90.99 | 500.00 | 0.04 | 90.99 |
| 499.00 | 0.04 | 90.99 | 499.00 | 0.04 | 90.99 |
| 498.00 | 0.04 | 90.99 | 498.00 | 0.04 | 90.99 |
| 497.00 | 0.04 | 90.99 | 497.00 | 0.04 | 90.78 |
| 496.00 | 0.04 | 90.99 | 496.00 | 0.04 | 90.99 |
| 495.00 | 0.04 | 90.99 | 495.00 | 0.04 | 90.99 |
| 494.00 | 0.04 | 90.99 | 494.00 | 0.04 | 90.99 |
| 493.00 | 0.04 | 91.20 | 493.00 | 0.04 | 90.99 |
| 492.00 | 0.04 | 91.20 | 492.00 | 0.04 | 90.99 |
| 491.00 | 0.04 | 91.20 | 491.00 | 0.04 | 90.99 |
| 490.00 | 0.04 | 91.20 | 490.00 | 0.04 | 90.99 |
| 489.00 | 0.04 | 90.99 | 489.00 | 0.04 | 90.99 |
| 488.00 | 0.04 | 90.99 | 488.00 | 0.04 | 90.99 |
| 487.00 | 0.04 | 90.99 | 487.00 | 0.04 | 90.99 |
| 486.00 | 0.04 | 90.99 | 486.00 | 0.04 | 90.99 |
| 485.00 | 0.04 | 91.20 | 485.00 | 0.04 | 91.20 |
| 484.00 | 0.04 | 91.20 | 484.00 | 0.04 | 91.20 |
| 483.00 | 0.04 | 91.20 | 483.00 | 0.04 | 90.99 |
| 482.00 | 0.04 | 91.20 | 482.00 | 0.04 | 90.99 |
| 481.00 | 0.04 | 90.99 | 481.00 | 0.04 | 90.99 |
| 480.00 | 0.04 | 90.99 | 480.00 | 0.04 | 90.78 |
| 479.00 | 0.04 | 90.99 | 479.00 | 0.04 | 90.78 |
| 478.00 | 0.04 | 90.99 | 478.00 | 0.04 | 90.78 |
| 477.00 | 0.04 | 90.99 | 477.00 | 0.04 | 90.78 |
| 476.00 | 0.04 | 90.99 | 476.00 | 0.04 | 90.99 |
| 475.00 | 0.04 | 90.99 | 475.00 | 0.04 | 90.99 |
| 474.00 | 0.04 | 90.99 | 474.00 | 0.04 | 90.99 |
| 473.00 | 0.04 | 90.99 | 473.00 | 0.04 | 90.99 |
| 472.00 | 0.04 | 90.78 | 472.00 | 0.04 | 90.99 |
| 471.00 | 0.04 | 90.99 | 471.00 | 0.04 | 90.99 |
| 470.00 | 0.04 | 90.99 | 470.00 | 0.04 | 90.99 |
| 469.00 | 0.04 | 90.99 | 469.00 | 0.04 | 90.99 |
| 468.00 | 0.04 | 90.99 | 468.00 | 0.04 | 90.99 |
| 467.00 | 0.04 | 90.99 | 467.00 | 0.04 | 90.99 |
| 466.00 | 0.04 | 90.99 | 466.00 | 0.04 | 90.99 |
| 465.00 | 0.04 | 90.99 | 465.00 | 0.04 | 90.99 |
| 464.00 | 0.04 | 90.99 | 464.00 | 0.04 | 90.78 |
| 463.00 | 0.04 | 90.99 | 463.00 | 0.04 | 90.78 |
| 462.00 | 0.04 | 90.99 | 462.00 | 0.04 | 90.78 |
| 461.00 | 0.04 | 90.99 | 461.00 | 0.04 | 90.78 |
| 460.00 | 0.04 | 90.99 | 460.00 | 0.04 | 90.78 |
| 459.00 | 0.04 | 90.99 | 459.00 | 0.04 | 90.99 |
| 458.00 | 0.04 | 90.99 | 458.00 | 0.04 | 90.99 |
| 457.00 | 0.04 | 90.99 | 457.00 | 0.04 | 90.99 |
| 456.00 | 0.04 | 90.99 | 456.00 | 0.04 | 90.99 |
| 455.00 | 0.04 | 90.99 | 455.00 | 0.04 | 90.99 |
| 454.00 | 0.04 | 91.20 | 454.00 | 0.04 | 90.99 |
| 453.00 | 0.04 | 90.99 | 453.00 | 0.04 | 90.99 |
| 452.00 | 0.04 | 90.99 | 452.00 | 0.04 | 90.99 |
| 451.00 | 0.04 | 90.99 | 451.00 | 0.04 | 90.99 |
| 450.00 | 0.04 | 90.99 | 450.00 | 0.04 | 90.99 |

Table A-3: Continued

| PMMA | | | 5wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 449.00 | 0.04 | 90.99 | 449.00 | 0.04 | 90.78 |
| 448.00 | 0.04 | 90.99 | 448.00 | 0.04 | 90.78 |
| 447.00 | 0.04 | 90.99 | 447.00 | 0.04 | 90.78 |
| 446.00 | 0.04 | 90.99 | 446.00 | 0.04 | 90.78 |
| 445.00 | 0.04 | 91.20 | 445.00 | 0.04 | 90.99 |
| 444.00 | 0.04 | 91.20 | 444.00 | 0.04 | 90.78 |
| 443.00 | 0.04 | 90.99 | 443.00 | 0.04 | 90.99 |
| 442.00 | 0.04 | 90.99 | 442.00 | 0.04 | 90.99 |
| 441.00 | 0.04 | 90.99 | 441.00 | 0.04 | 90.78 |
| 440.00 | 0.04 | 90.99 | 440.00 | 0.04 | 90.78 |
| 439.00 | 0.04 | 90.99 | 439.00 | 0.04 | 90.78 |
| 438.00 | 0.04 | 90.78 | 438.00 | 0.04 | 90.78 |
| 437.00 | 0.04 | 90.78 | 437.00 | 0.04 | 90.78 |
| 436.00 | 0.04 | 90.78 | 436.00 | 0.04 | 90.78 |
| 435.00 | 0.04 | 90.78 | 435.00 | 0.04 | 90.78 |
| 434.00 | 0.04 | 90.99 | 434.00 | 0.04 | 90.57 |
| 433.00 | 0.04 | 90.99 | 433.00 | 0.04 | 90.78 |
| 432.00 | 0.04 | 90.99 | 432.00 | 0.04 | 90.78 |
| 431.00 | 0.04 | 90.99 | 431.00 | 0.04 | 90.78 |
| 430.00 | 0.04 | 90.99 | 430.00 | 0.04 | 90.78 |
| 429.00 | 0.04 | 90.99 | 429.00 | 0.04 | 90.78 |
| 428.00 | 0.04 | 90.99 | 428.00 | 0.04 | 90.78 |
| 427.00 | 0.04 | 90.99 | 427.00 | 0.04 | 90.78 |
| 426.00 | 0.04 | 90.99 | 426.00 | 0.04 | 90.78 |
| 425.00 | 0.04 | 90.99 | 425.00 | 0.04 | 90.78 |
| 424.00 | 0.04 | 90.99 | 424.00 | 0.04 | 90.78 |
| 423.00 | 0.04 | 90.99 | 423.00 | 0.04 | 90.78 |
| 422.00 | 0.04 | 90.99 | 422.00 | 0.04 | 90.78 |
| 421.00 | 0.04 | 90.78 | 421.00 | 0.04 | 90.78 |
| 420.00 | 0.04 | 90.78 | 420.00 | 0.04 | 90.78 |
| 419.00 | 0.04 | 90.78 | 419.00 | 0.04 | 90.78 |
| 418.00 | 0.04 | 90.99 | 418.00 | 0.04 | 90.78 |
| 417.00 | 0.04 | 90.99 | 417.00 | 0.04 | 90.78 |
| 416.00 | 0.04 | 90.78 | 416.00 | 0.04 | 90.57 |
| 415.00 | 0.04 | 90.78 | 415.00 | 0.04 | 90.57 |
| 414.00 | 0.04 | 90.78 | 414.00 | 0.04 | 90.57 |
| 413.00 | 0.04 | 90.99 | 413.00 | 0.04 | 90.57 |
| 412.00 | 0.04 | 90.99 | 412.00 | 0.04 | 90.57 |
| 411.00 | 0.04 | 90.99 | 411.00 | 0.04 | 90.57 |
| 410.00 | 0.04 | 90.99 | 410.00 | 0.04 | 90.78 |
| 409.00 | 0.04 | 90.99 | 409.00 | 0.04 | 90.78 |
| 408.00 | 0.04 | 90.99 | 408.00 | 0.04 | 90.57 |
| 407.00 | 0.04 | 90.99 | 407.00 | 0.04 | 90.57 |
| 406.00 | 0.04 | 90.78 | 406.00 | 0.04 | 90.36 |
| 405.00 | 0.04 | 90.78 | 405.00 | 0.04 | 90.36 |
| 404.00 | 0.04 | 90.57 | 404.00 | 0.04 | 90.36 |
| 403.00 | 0.04 | 90.57 | 403.00 | 0.04 | 90.36 |
| 402.00 | 0.04 | 90.57 | 402.00 | 0.04 | 90.36 |
| 401.00 | 0.04 | 90.57 | 401.00 | 0.04 | 90.36 |
| 400.00 | 0.04 | 90.57 | 400.00 | 0.04 | 90.57 |
| 399.00 | 0.04 | 90.57 | 399.00 | 0.04 | 90.36 |
| 398.00 | 0.04 | 90.57 | 398.00 | 0.04 | 90.36 |
| 397.00 | 0.04 | 90.78 | 397.00 | 0.04 | 90.36 |
| 396.00 | 0.04 | 90.78 | 396.00 | 0.04 | 90.36 |
| 395.00 | 0.04 | 90.78 | 395.00 | 0.04 | 90.36 |
| 394.00 | 0.04 | 90.78 | 394.00 | 0.04 | 90.36 |
| 393.00 | 0.04 | 90.78 | 393.00 | 0.05 | 90.16 |
| 392.00 | 0.04 | 90.57 | 392.00 | 0.05 | 90.16 |
| 391.00 | 0.04 | 90.78 | 391.00 | 0.04 | 90.36 |
| 390.00 | 0.04 | 90.78 | 390.00 | 0.04 | 90.36 |
| 389.00 | 0.04 | 90.78 | 389.00 | 0.04 | 90.36 |
| 388.00 | 0.04 | 90.57 | 388.00 | 0.04 | 90.36 |
| 387.00 | 0.04 | 90.57 | 387.00 | 0.04 | 90.36 |
| 386.00 | 0.04 | 90.57 | 386.00 | 0.05 | 90.16 |

Table A-3: Continued

| PMMA | | | 5wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 385.00 | 0.05 | 90.16 | 385.00 | 0.05 | 89.95 |
| 384.00 | 0.05 | 90.16 | 384.00 | 0.05 | 89.74 |
| 383.00 | 0.05 | 89.95 | 383.00 | 0.05 | 89.95 |
| 382.00 | 0.05 | 89.95 | 382.00 | 0.05 | 89.95 |
| 381.00 | 0.05 | 90.16 | 381.00 | 0.05 | 89.95 |
| 380.00 | 0.05 | 90.16 | 380.00 | 0.05 | 90.16 |
| 379.00 | 0.04 | 90.36 | 379.00 | 0.05 | 90.16 |
| 378.00 | 0.05 | 90.16 | 378.00 | 0.05 | 90.16 |
| 377.00 | 0.05 | 90.16 | 377.00 | 0.05 | 90.16 |
| 376.00 | 0.05 | 90.16 | 376.00 | 0.05 | 89.95 |
| 375.00 | 0.05 | 89.95 | 375.00 | 0.05 | 89.95 |
| 374.00 | 0.05 | 89.95 | 374.00 | 0.05 | 89.74 |
| 373.00 | 0.05 | 89.95 | 373.00 | 0.05 | 89.95 |
| 372.00 | 0.05 | 90.16 | 372.00 | 0.05 | 89.74 |
| 371.00 | 0.05 | 90.16 | 371.00 | 0.05 | 89.74 |
| 370.00 | 0.04 | 90.36 | 370.00 | 0.05 | 89.74 |
| 369.00 | 0.04 | 90.36 | 369.00 | 0.05 | 89.95 |
| 368.00 | 0.04 | 90.57 | 368.00 | 0.05 | 90.16 |
| 367.00 | 0.04 | 90.57 | 367.00 | 0.05 | 90.16 |
| 366.00 | 0.04 | 90.57 | 366.00 | 0.05 | 89.95 |
| 365.00 | 0.04 | 90.57 | 365.00 | 0.05 | 90.16 |
| 364.00 | 0.04 | 90.36 | 364.00 | 0.05 | 89.95 |
| 363.00 | 0.05 | 90.16 | 363.00 | 0.05 | 89.95 |
| 362.00 | 0.05 | 89.95 | 362.00 | 0.05 | 89.54 |
| 361.00 | 0.05 | 89.95 | 361.00 | 0.05 | 89.54 |
| 360.00 | 0.05 | 89.74 | 360.00 | 0.05 | 89.33 |
| 359.00 | 0.05 | 89.74 | 359.00 | 0.05 | 89.54 |
| 358.00 | 0.05 | 89.74 | 358.00 | 0.05 | 89.33 |
| 357.00 | 0.05 | 89.95 | 357.00 | 0.05 | 89.33 |
| 356.00 | 0.05 | 89.95 | 356.00 | 0.05 | 89.33 |
| 355.00 | 0.05 | 89.95 | 355.00 | 0.05 | 89.54 |
| 354.00 | 0.05 | 89.95 | 354.00 | 0.05 | 89.54 |
| 353.00 | 0.05 | 89.95 | 353.00 | 0.05 | 89.33 |
| 352.00 | 0.05 | 89.74 | 352.00 | 0.05 | 89.33 |
| 351.00 | 0.05 | 89.74 | 351.00 | 0.05 | 89.33 |
| 350.00 | 0.05 | 89.74 | 350.00 | 0.05 | 89.33 |
| 349.00 | 0.05 | 89.74 | 349.00 | 0.05 | 89.54 |
| 348.00 | 0.05 | 89.95 | 348.00 | 0.05 | 89.54 |
| 347.00 | 0.05 | 89.95 | 347.00 | 0.05 | 89.54 |
| 346.00 | 0.05 | 89.95 | 346.00 | 0.05 | 89.33 |
| 345.00 | 0.05 | 89.74 | 345.00 | 0.05 | 89.13 |
| 344.00 | 0.05 | 89.74 | 344.00 | 0.05 | 89.13 |
| 343.00 | 0.05 | 89.74 | 343.00 | 0.05 | 89.13 |
| 342.00 | 0.05 | 89.74 | 342.00 | 0.05 | 89.13 |
| 341.00 | 0.05 | 89.95 | 341.00 | 0.05 | 89.33 |
| 340.00 | 0.05 | 89.74 | 340.00 | 0.05 | 89.13 |
| 339.00 | 0.05 | 89.74 | 339.00 | 0.05 | 89.33 |
| 338.00 | 0.05 | 89.54 | 338.00 | 0.05 | 89.33 |
| 337.00 | 0.05 | 89.33 | 337.00 | 0.05 | 89.13 |
| 336.00 | 0.05 | 89.13 | 336.00 | 0.05 | 88.92 |
| 335.00 | 0.05 | 88.92 | 335.00 | 0.05 | 88.92 |
| 334.00 | 0.05 | 88.92 | 334.00 | 0.05 | 88.72 |
| 333.00 | 0.05 | 89.13 | 333.00 | 0.05 | 88.92 |
| 332.00 | 0.05 | 89.13 | 332.00 | 0.05 | 88.92 |
| 331.00 | 0.05 | 89.13 | 331.00 | 0.05 | 89.13 |
| 330.00 | 0.05 | 89.33 | 330.00 | 0.05 | 89.33 |
| 329.00 | 0.05 | 89.33 | 329.00 | 0.05 | 89.13 |
| 328.00 | 0.05 | 89.13 | 328.00 | 0.05 | 89.13 |
| 327.00 | 0.05 | 89.33 | 327.00 | 0.05 | 88.92 |
| 326.00 | 0.05 | 89.33 | 326.00 | 0.05 | 88.72 |
| 325.00 | 0.05 | 89.54 | 325.00 | 0.05 | 88.51 |
| 324.00 | 0.05 | 89.54 | 324.00 | 0.05 | 88.51 |
| 323.00 | 0.05 | 89.74 | 323.00 | 0.05 | 88.51 |
| 322.00 | 0.05 | 89.54 | 322.00 | 0.05 | 88.72 |

Table A-3: Continued

| | PMMA | | | 5wt% ZrP in PMMA | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 321.00 | 0.05 | 89.54 | 321.00 | 0.05 | 88.72 |
| 320.00 | 0.05 | 89.54 | 320.00 | 0.05 | 88.72 |
| 319.00 | 0.05 | 89.13 | 319.00 | 0.05 | 88.92 |
| 318.00 | 0.05 | 88.92 | 318.00 | 0.05 | 88.72 |
| 317.00 | 0.05 | 88.92 | 317.00 | 0.05 | 88.51 |
| 316.00 | 0.05 | 88.72 | 316.00 | 0.05 | 88.31 |
| 315.00 | 0.05 | 88.72 | 315.00 | 0.06 | 88.10 |
| 314.00 | 0.05 | 88.51 | 314.00 | 0.06 | 88.10 |
| 313.00 | 0.05 | 88.51 | 313.00 | 0.06 | 87.70 |
| 312.00 | 0.05 | 88.51 | 312.00 | 0.06 | 87.70 |
| 311.00 | 0.05 | 88.31 | 311.00 | 0.06 | 87.50 |
| 310.00 | 0.05 | 88.31 | 310.00 | 0.06 | 87.50 |
| 309.00 | 0.05 | 88.51 | 309.00 | 0.06 | 87.50 |
| 308.00 | 0.05 | 88.51 | 308.00 | 0.06 | 87.70 |
| 307.00 | 0.05 | 88.51 | 307.00 | 0.06 | 87.50 |
| 306.00 | 0.05 | 88.51 | 306.00 | 0.06 | 87.30 |
| 305.00 | 0.05 | 88.31 | 305.00 | 0.06 | 87.30 |
| 304.00 | 0.05 | 88.31 | 304.00 | 0.06 | 87.50 |
| 303.00 | 0.06 | 88.10 | 303.00 | 0.06 | 87.30 |
| 302.00 | 0.06 | 88.10 | 302.00 | 0.06 | 87.10 |
| 301.00 | 0.06 | 88.10 | 301.00 | 0.06 | 87.10 |
| 300.00 | 0.06 | 87.90 | 300.00 | 0.06 | 86.90 |
| 299.00 | 0.06 | 87.90 | 299.00 | 0.06 | 86.70 |
| 298.00 | 0.06 | 87.90 | 298.00 | 0.06 | 86.70 |
| 297.00 | 0.06 | 87.50 | 297.00 | 0.06 | 86.50 |
| 296.00 | 0.06 | 87.30 | 296.00 | 0.06 | 86.30 |
| 295.00 | 0.06 | 87.10 | 295.00 | 0.07 | 86.10 |
| 294.00 | 0.06 | 86.90 | 294.00 | 0.07 | 85.90 |
| 293.00 | 0.06 | 86.90 | 293.00 | 0.07 | 85.70 |
| 292.00 | 0.06 | 86.90 | 292.00 | 0.07 | 85.70 |
| 291.00 | 0.06 | 87.10 | 291.00 | 0.07 | 85.51 |
| 290.00 | 0.06 | 87.30 | 290.00 | 0.07 | 85.51 |
| 289.00 | 0.06 | 87.30 | 289.00 | 0.07 | 85.51 |
| 288.00 | 0.06 | 87.30 | 288.00 | 0.07 | 85.51 |
| 287.00 | 0.06 | 87.10 | 287.00 | 0.07 | 85.31 |
| 286.00 | 0.06 | 87.10 | 286.00 | 0.07 | 84.92 |
| 285.00 | 0.06 | 86.90 | 285.00 | 0.07 | 84.72 |
| 284.00 | 0.06 | 86.70 | 284.00 | 0.07 | 84.53 |
| 283.00 | 0.06 | 86.30 | 283.00 | 0.08 | 84.14 |
| 282.00 | 0.06 | 86.30 | 282.00 | 0.08 | 83.75 |
| 281.00 | 0.06 | 86.50 | 281.00 | 0.08 | 83.75 |
| 280.00 | 0.06 | 86.70 | 280.00 | 0.08 | 83.56 |
| 279.00 | 0.06 | 86.70 | 279.00 | 0.08 | 83.37 |
| 278.00 | 0.06 | 86.70 | 278.00 | 0.08 | 83.37 |
| 277.00 | 0.06 | 86.70 | 277.00 | 0.08 | 83.18 |
| 276.00 | 0.06 | 86.70 | 276.00 | 0.08 | 82.79 |
| 275.00 | 0.06 | 86.70 | 275.00 | 0.08 | 82.41 |
| 274.00 | 0.06 | 86.50 | 274.00 | 0.09 | 82.04 |
| 273.00 | 0.07 | 86.10 | 273.00 | 0.09 | 81.47 |
| 272.00 | 0.07 | 86.10 | 272.00 | 0.09 | 81.28 |
| 271.00 | 0.06 | 86.30 | 271.00 | 0.09 | 81.10 |
| 270.00 | 0.06 | 86.30 | 270.00 | 0.09 | 80.91 |
| 269.00 | 0.06 | 86.30 | 269.00 | 0.09 | 80.72 |
| 268.00 | 0.06 | 86.30 | 268.00 | 0.10 | 80.17 |
| 267.00 | 0.07 | 86.10 | 267.00 | 0.10 | 79.62 |
| 266.00 | 0.07 | 86.10 | 266.00 | 0.10 | 79.07 |
| 265.00 | 0.07 | 85.51 | 265.00 | 0.11 | 78.34 |
| 264.00 | 0.07 | 85.11 | 264.00 | 0.11 | 77.45 |
| 263.00 | 0.07 | 84.33 | 263.00 | 0.12 | 76.74 |
| 262.00 | 0.08 | 83.56 | 262.00 | 0.12 | 75.51 |
| 261.00 | 0.08 | 82.99 | 261.00 | 0.13 | 74.47 |
| 260.00 | 0.09 | 82.04 | 260.00 | 0.14 | 72.95 |
| 259.00 | 0.09 | 80.54 | 259.00 | 0.15 | 70.96 |
| 258.00 | 0.11 | 78.52 | 258.00 | 0.16 | 68.87 |

Table A-3: Continued

| PMMA | | | 5wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 254.00 | 0.20 | 63.53 | 254.00 | 0.27 | 53.83 |
| 253.00 | 0.25 | 56.62 | 253.00 | 0.33 | 47.32 |
| 252.00 | 0.31 | 49.43 | 252.00 | 0.39 | 40.74 |
| 251.00 | 0.37 | 42.76 | 251.00 | 0.46 | 34.75 |
| 250.00 | 0.43 | 37.50 | 250.00 | 0.52 | 29.99 |

Table A-4: UV-vis Spectroscopy Data for 10wt% and 30wt% ZrP in PMMA

| 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 900 | 0.005 | 98.86 | 900 | 0.02 | 95.50 |
| 899 | 0.015 | 96.61 | 899 | 0.035 | 92.26 |
| 898 | 0.03 | 93.33 | 898 | 0.056 | 87.90 |
| 897 | 0.037 | 91.83 | 897 | 0.067 | 85.70 |
| 896 | 0.043 | 90.57 | 896 | 0.072 | 84.72 |
| 895 | 0.046 | 89.95 | 895 | 0.068 | 85.51 |
| 894 | 0.047 | 89.74 | 894 | 0.061 | 86.90 |
| 893 | 0.042 | 90.78 | 893 | 0.051 | 88.92 |
| 892 | 0.047 | 89.74 | 892 | 0.048 | 89.54 |
| 891 | 0.044 | 90.36 | 891 | 0.051 | 88.92 |
| 890 | 0.045 | 90.16 | 890 | 0.046 | 89.95 |
| 889 | 0.041 | 90.99 | 889 | 0.051 | 88.92 |
| 888 | 0.035 | 92.26 | 888 | 0.053 | 88.51 |
| 887 | 0.04 | 91.20 | 887 | 0.062 | 86.70 |
| 886 | 0.044 | 90.36 | 886 | 0.068 | 85.51 |
| 885 | 0.043 | 90.57 | 885 | 0.065 | 86.10 |
| 884 | 0.051 | 88.92 | 884 | 0.071 | 84.92 |
| 883 | 0.051 | 88.92 | 883 | 0.068 | 85.51 |
| 882 | 0.053 | 88.51 | 882 | 0.067 | 85.70 |
| 881 | 0.056 | 87.90 | 881 | 0.065 | 86.10 |
| 880 | 0.062 | 86.70 | 880 | 0.07 | 85.11 |
| 879 | 0.062 | 86.70 | 879 | 0.069 | 85.31 |
| 878 | 0.066 | 85.90 | 878 | 0.067 | 85.70 |
| 877 | 0.067 | 85.70 | 877 | 0.06 | 87.10 |
| 876 | 0.07 | 85.11 | 876 | 0.054 | 88.31 |
| 875 | 0.064 | 86.30 | 875 | 0.052 | 88.72 |
| 874 | 0.056 | 87.90 | 874 | 0.051 | 88.92 |
| 873 | 0.057 | 87.70 | 873 | 0.056 | 87.90 |
| 872 | 0.053 | 88.51 | 872 | 0.059 | 87.30 |
| 871 | 0.045 | 90.16 | 871 | 0.057 | 87.70 |
| 870 | 0.041 | 90.99 | 870 | 0.058 | 87.50 |
| 869 | 0.04 | 91.20 | 869 | 0.055 | 88.10 |
| 868 | 0.04 | 91.20 | 868 | 0.055 | 88.10 |
| 867 | 0.042 | 90.78 | 867 | 0.053 | 88.51 |
| 866 | 0.046 | 89.95 | 866 | 0.054 | 88.31 |
| 865 | 0.051 | 88.92 | 865 | 0.055 | 88.10 |
| 864 | 0.056 | 87.90 | 864 | 0.06 | 87.10 |
| 863 | 0.061 | 86.90 | 863 | 0.062 | 86.70 |
| 862 | 0.061 | 86.90 | 862 | 0.063 | 86.50 |
| 861 | 0.056 | 87.90 | 861 | 0.062 | 86.70 |
| 860 | 0.052 | 88.72 | 860 | 0.06 | 87.10 |
| 859 | 0.053 | 88.51 | 859 | 0.061 | 86.90 |
| 858 | 0.053 | 88.51 | 858 | 0.061 | 86.90 |
| 857 | 0.052 | 88.72 | 857 | 0.06 | 87.10 |
| 856 | 0.052 | 88.72 | 856 | 0.059 | 87.30 |
| 855 | 0.053 | 88.51 | 855 | 0.056 | 87.90 |
| 854 | 0.052 | 88.72 | 854 | 0.056 | 87.90 |
| 853 | 0.053 | 88.51 | 853 | 0.055 | 88.10 |
| 852 | 0.051 | 88.92 | 852 | 0.055 | 88.10 |
| 851 | 0.051 | 88.92 | 851 | 0.054 | 88.31 |
| 850 | 0.051 | 88.92 | 850 | 0.055 | 88.10 |
| 849 | 0.052 | 88.72 | 849 | 0.057 | 87.70 |
| 848 | 0.054 | 88.31 | 848 | 0.059 | 87.30 |
| 847 | 0.054 | 88.31 | 847 | 0.061 | 86.90 |
| 846 | 0.053 | 88.51 | 846 | 0.062 | 86.70 |
| 845 | 0.053 | 88.51 | 845 | 0.061 | 86.90 |
| 844 | 0.051 | 88.92 | 844 | 0.06 | 87.10 |
| 843 | 0.051 | 88.92 | 843 | 0.059 | 87.30 |
| 842 | 0.052 | 88.72 | 842 | 0.059 | 87.30 |
| 841 | 0.051 | 88.92 | 841 | 0.057 | 87.70 |
| 840 | 0.051 | 88.92 | 840 | 0.057 | 87.70 |
| 839 | 0.052 | 88.72 | 839 | 0.057 | 87.70 |
| 838 | 0.052 | 88.72 | 838 | 0.057 | 87.70 |
| 837 | 0.053 | 88.51 | 837 | 0.058 | 87.50 |
| 836 | 0.054 | 88.31 | 836 | 0.059 | 87.30 |
| 835 | 0.054 | 88.31 | 835 | 0.058 | 87.50 |
| 834 | 0.054 | 88.31 | 834 | 0.058 | 87.50 |

Table A-4: Continued

| 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 833 | 0.054 | 88.31 | 833 | 0.059 | 87.30 |
| 832 | 0.053 | 88.51 | 832 | 0.059 | 87.30 |
| 831 | 0.052 | 88.72 | 831 | 0.058 | 87.50 |
| 830 | 0.052 | 88.72 | 830 | 0.058 | 87.50 |
| 829 | 0.052 | 88.72 | 829 | 0.058 | 87.50 |
| 828 | 0.051 | 88.92 | 828 | 0.058 | 87.50 |
| 827 | 0.051 | 88.92 | 827 | 0.058 | 87.50 |
| 826 | 0.051 | 88.92 | 826 | 0.058 | 87.50 |
| 825 | 0.051 | 88.92 | 825 | 0.058 | 87.50 |
| 824 | 0.051 | 88.92 | 824 | 0.058 | 87.50 |
| 823 | 0.052 | 88.72 | 823 | 0.058 | 87.50 |
| 822 | 0.053 | 88.51 | 822 | 0.058 | 87.50 |
| 821 | 0.053 | 88.51 | 821 | 0.058 | 87.50 |
| 820 | 0.054 | 88.31 | 820 | 0.059 | 87.30 |
| 819 | 0.055 | 88.10 | 819 | 0.06 | 87.10 |
| 818 | 0.054 | 88.31 | 818 | 0.06 | 87.10 |
| 817 | 0.054 | 88.31 | 817 | 0.06 | 87.10 |
| 816 | 0.054 | 88.31 | 816 | 0.06 | 87.10 |
| 815 | 0.054 | 88.31 | 815 | 0.06 | 87.10 |
| 814 | 0.053 | 88.51 | 814 | 0.059 | 87.30 |
| 813 | 0.054 | 88.31 | 813 | 0.058 | 87.50 |
| 812 | 0.053 | 88.51 | 812 | 0.058 | 87.50 |
| 811 | 0.053 | 88.51 | 811 | 0.058 | 87.50 |
| 810 | 0.053 | 88.51 | 810 | 0.058 | 87.50 |
| 809 | 0.052 | 88.72 | 809 | 0.057 | 87.70 |
| 808 | 0.052 | 88.72 | 808 | 0.057 | 87.70 |
| 807 | 0.052 | 88.72 | 807 | 0.058 | 87.50 |
| 806 | 0.053 | 88.51 | 806 | 0.059 | 87.30 |
| 805 | 0.053 | 88.51 | 805 | 0.06 | 87.10 |
| 804 | 0.053 | 88.51 | 804 | 0.06 | 87.10 |
| 803 | 0.053 | 88.51 | 803 | 0.06 | 87.10 |
| 802 | 0.053 | 88.51 | 802 | 0.059 | 87.30 |
| 801 | 0.053 | 88.51 | 801 | 0.058 | 87.50 |
| 800 | 0.053 | 88.51 | 800 | 0.057 | 87.70 |
| 799 | 0.054 | 88.31 | 799 | 0.058 | 87.50 |
| 798 | 0.054 | 88.31 | 798 | 0.059 | 87.30 |
| 797 | 0.054 | 88.31 | 797 | 0.06 | 87.10 |
| 796 | 0.054 | 88.31 | 796 | 0.061 | 86.90 |
| 795 | 0.053 | 88.51 | 795 | 0.061 | 86.90 |
| 794 | 0.053 | 88.51 | 794 | 0.061 | 86.90 |
| 793 | 0.053 | 88.51 | 793 | 0.06 | 87.10 |
| 792 | 0.053 | 88.51 | 792 | 0.059 | 87.30 |
| 791 | 0.053 | 88.51 | 791 | 0.059 | 87.30 |
| 790 | 0.053 | 88.51 | 790 | 0.059 | 87.30 |
| 789 | 0.053 | 88.51 | 789 | 0.059 | 87.30 |
| 788 | 0.053 | 88.51 | 788 | 0.059 | 87.30 |
| 787 | 0.054 | 88.31 | 787 | 0.059 | 87.30 |
| 786 | 0.054 | 88.31 | 786 | 0.059 | 87.30 |
| 785 | 0.054 | 88.31 | 785 | 0.059 | 87.30 |
| 784 | 0.053 | 88.51 | 784 | 0.059 | 87.30 |
| 783 | 0.053 | 88.51 | 783 | 0.06 | 87.10 |
| 782 | 0.053 | 88.51 | 782 | 0.059 | 87.30 |
| 781 | 0.054 | 88.31 | 781 | 0.06 | 87.10 |
| 780 | 0.055 | 88.10 | 780 | 0.06 | 87.10 |
| 779 | 0.056 | 87.90 | 779 | 0.061 | 86.90 |
| 778 | 0.056 | 87.90 | 778 | 0.061 | 86.90 |
| 777 | 0.056 | 87.90 | 777 | 0.061 | 86.90 |
| 776 | 0.056 | 87.90 | 776 | 0.061 | 86.90 |
| 775 | 0.055 | 88.10 | 775 | 0.06 | 87.10 |
| 774 | 0.055 | 88.10 | 774 | 0.06 | 87.10 |
| 773 | 0.054 | 88.31 | 773 | 0.06 | 87.10 |
| 772 | 0.053 | 88.51 | 772 | 0.06 | 87.10 |
| 771 | 0.054 | 88.31 | 771 | 0.06 | 87.10 |
| 770 | 0.055 | 88.10 | 770 | 0.06 | 87.10 |

Table A-4: Continued

| 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 769 | 0.055 | 88.10 | 769 | 0.06 | 87.10 |
| 768 | 0.055 | 88.10 | 768 | 0.06 | 87.10 |
| 767 | 0.055 | 88.10 | 767 | 0.06 | 87.10 |
| 766 | 0.055 | 88.10 | 766 | 0.06 | 87.10 |
| 765 | 0.055 | 88.10 | 765 | 0.061 | 86.90 |
| 764 | 0.055 | 88.10 | 764 | 0.061 | 86.90 |
| 763 | 0.055 | 88.10 | 763 | 0.061 | 86.90 |
| 762 | 0.055 | 88.10 | 762 | 0.061 | 86.90 |
| 761 | 0.056 | 87.90 | 761 | 0.061 | 86.90 |
| 760 | 0.056 | 87.90 | 760 | 0.061 | 86.90 |
| 759 | 0.056 | 87.90 | 759 | 0.061 | 86.90 |
| 758 | 0.055 | 88.10 | 758 | 0.06 | 87.10 |
| 757 | 0.055 | 88.10 | 757 | 0.061 | 86.90 |
| 756 | 0.055 | 88.10 | 756 | 0.061 | 86.90 |
| 755 | 0.055 | 88.10 | 755 | 0.061 | 86.90 |
| 754 | 0.056 | 87.90 | 754 | 0.062 | 86.70 |
| 753 | 0.056 | 87.90 | 753 | 0.062 | 86.70 |
| 752 | 0.056 | 87.90 | 752 | 0.062 | 86.70 |
| 751 | 0.056 | 87.90 | 751 | 0.061 | 86.90 |
| 750 | 0.055 | 88.10 | 750 | 0.061 | 86.90 |
| 749 | 0.056 | 87.90 | 749 | 0.061 | 86.90 |
| 748 | 0.055 | 88.10 | 748 | 0.061 | 86.90 |
| 747 | 0.055 | 88.10 | 747 | 0.061 | 86.90 |
| 746 | 0.056 | 87.90 | 746 | 0.061 | 86.90 |
| 745 | 0.056 | 87.90 | 745 | 0.061 | 86.90 |
| 744 | 0.055 | 88.10 | 744 | 0.061 | 86.90 |
| 743 | 0.055 | 88.10 | 743 | 0.061 | 86.90 |
| 742 | 0.055 | 88.10 | 742 | 0.061 | 86.90 |
| 741 | 0.055 | 88.10 | 741 | 0.061 | 86.90 |
| 740 | 0.055 | 88.10 | 740 | 0.061 | 86.90 |
| 739 | 0.055 | 88.10 | 739 | 0.061 | 86.90 |
| 738 | 0.055 | 88.10 | 738 | 0.061 | 86.90 |
| 737 | 0.055 | 88.10 | 737 | 0.061 | 86.90 |
| 736 | 0.055 | 88.10 | 736 | 0.061 | 86.90 |
| 735 | 0.055 | 88.10 | 735 | 0.061 | 86.90 |
| 734 | 0.055 | 88.10 | 734 | 0.061 | 86.90 |
| 733 | 0.055 | 88.10 | 733 | 0.061 | 86.90 |
| 732 | 0.055 | 88.10 | 732 | 0.061 | 86.90 |
| 731 | 0.055 | 88.10 | 731 | 0.061 | 86.90 |
| 730 | 0.055 | 88.10 | 730 | 0.061 | 86.90 |
| 729 | 0.055 | 88.10 | 729 | 0.062 | 86.70 |
| 728 | 0.055 | 88.10 | 728 | 0.062 | 86.70 |
| 727 | 0.056 | 87.90 | 727 | 0.062 | 86.70 |
| 726 | 0.056 | 87.90 | 726 | 0.061 | 86.90 |
| 725 | 0.056 | 87.90 | 725 | 0.061 | 86.90 |
| 724 | 0.056 | 87.90 | 724 | 0.061 | 86.90 |
| 723 | 0.056 | 87.90 | 723 | 0.061 | 86.90 |
| 722 | 0.055 | 88.10 | 722 | 0.06 | 87.10 |
| 721 | 0.055 | 88.10 | 721 | 0.061 | 86.90 |
| 720 | 0.055 | 88.10 | 720 | 0.061 | 86.90 |
| 719 | 0.055 | 88.10 | 719 | 0.061 | 86.90 |
| 718 | 0.055 | 88.10 | 718 | 0.062 | 86.70 |
| 717 | 0.055 | 88.10 | 717 | 0.062 | 86.70 |
| 716 | 0.055 | 88.10 | 716 | 0.062 | 86.70 |
| 715 | 0.055 | 88.10 | 715 | 0.062 | 86.70 |
| 714 | 0.056 | 87.90 | 714 | 0.062 | 86.70 |
| 713 | 0.056 | 87.90 | 713 | 0.062 | 86.70 |
| 712 | 0.056 | 87.90 | 712 | 0.062 | 86.70 |
| 711 | 0.056 | 87.90 | 711 | 0.061 | 86.90 |
| 710 | 0.056 | 87.90 | 710 | 0.062 | 86.70 |
| 709 | 0.056 | 87.90 | 709 | 0.062 | 86.70 |
| 708 | 0.056 | 87.90 | 708 | 0.062 | 86.70 |
| 707 | 0.056 | 87.90 | 707 | 0.062 | 86.70 |
| 706 | 0.055 | 88.10 | 706 | 0.062 | 86.70 |

Table A-4: Continued

| 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 705 | 0.055 | 88.10 | 705 | 0.062 | 86.70 |
| 704 | 0.055 | 88.10 | 704 | 0.063 | 86.50 |
| 703 | 0.056 | 87.90 | 703 | 0.063 | 86.50 |
| 702 | 0.056 | 87.90 | 702 | 0.063 | 86.50 |
| 701 | 0.056 | 87.90 | 701 | 0.063 | 86.50 |
| 700 | 0.057 | 87.70 | 700 | 0.063 | 86.50 |
| 699 | 0.056 | 87.90 | 699 | 0.063 | 86.50 |
| 698 | 0.057 | 87.70 | 698 | 0.063 | 86.50 |
| 697 | 0.056 | 87.90 | 697 | 0.062 | 86.70 |
| 696 | 0.056 | 87.90 | 696 | 0.062 | 86.70 |
| 695 | 0.056 | 87.90 | 695 | 0.062 | 86.70 |
| 694 | 0.056 | 87.90 | 694 | 0.063 | 86.50 |
| 693 | 0.057 | 87.70 | 693 | 0.063 | 86.50 |
| 692 | 0.057 | 87.70 | 692 | 0.062 | 86.70 |
| 691 | 0.057 | 87.70 | 691 | 0.063 | 86.50 |
| 690 | 0.057 | 87.70 | 690 | 0.063 | 86.50 |
| 689 | 0.057 | 87.70 | 689 | 0.063 | 86.50 |
| 688 | 0.057 | 87.70 | 688 | 0.063 | 86.50 |
| 687 | 0.057 | 87.70 | 687 | 0.063 | 86.50 |
| 686 | 0.057 | 87.70 | 686 | 0.063 | 86.50 |
| 685 | 0.057 | 87.70 | 685 | 0.063 | 86.50 |
| 684 | 0.057 | 87.70 | 684 | 0.063 | 86.50 |
| 683 | 0.057 | 87.70 | 683 | 0.063 | 86.50 |
| 682 | 0.057 | 87.70 | 682 | 0.063 | 86.50 |
| 681 | 0.057 | 87.70 | 681 | 0.063 | 86.50 |
| 680 | 0.057 | 87.70 | 680 | 0.063 | 86.50 |
| 679 | 0.057 | 87.70 | 679 | 0.064 | 86.30 |
| 678 | 0.057 | 87.70 | 678 | 0.064 | 86.30 |
| 677 | 0.057 | 87.70 | 677 | 0.064 | 86.30 |
| 676 | 0.057 | 87.70 | 676 | 0.064 | 86.30 |
| 675 | 0.057 | 87.70 | 675 | 0.064 | 86.30 |
| 674 | 0.057 | 87.70 | 674 | 0.064 | 86.30 |
| 673 | 0.057 | 87.70 | 673 | 0.064 | 86.30 |
| 672 | 0.057 | 87.70 | 672 | 0.064 | 86.30 |
| 671 | 0.057 | 87.70 | 671 | 0.064 | 86.30 |
| 670 | 0.058 | 87.50 | 670 | 0.064 | 86.30 |
| 669 | 0.058 | 87.50 | 669 | 0.064 | 86.30 |
| 668 | 0.058 | 87.50 | 668 | 0.064 | 86.30 |
| 667 | 0.058 | 87.50 | 667 | 0.064 | 86.30 |
| 666 | 0.058 | 87.50 | 666 | 0.064 | 86.30 |
| 665 | 0.058 | 87.50 | 665 | 0.064 | 86.30 |
| 664 | 0.058 | 87.50 | 664 | 0.064 | 86.30 |
| 663 | 0.058 | 87.50 | 663 | 0.064 | 86.30 |
| 662 | 0.058 | 87.50 | 662 | 0.064 | 86.30 |
| 661 | 0.058 | 87.50 | 661 | 0.064 | 86.30 |
| 660 | 0.058 | 87.50 | 660 | 0.064 | 86.30 |
| 659 | 0.058 | 87.50 | 659 | 0.064 | 86.30 |
| 658 | 0.058 | 87.50 | 658 | 0.064 | 86.30 |
| 657 | 0.058 | 87.50 | 657 | 0.064 | 86.30 |
| 656 | 0.058 | 87.50 | 656 | 0.064 | 86.30 |
| 655 | 0.058 | 87.50 | 655 | 0.064 | 86.30 |
| 654 | 0.058 | 87.50 | 654 | 0.064 | 86.30 |
| 653 | 0.058 | 87.50 | 653 | 0.064 | 86.30 |
| 652 | 0.058 | 87.50 | 652 | 0.064 | 86.30 |
| 651 | 0.058 | 87.50 | 651 | 0.064 | 86.30 |
| 650 | 0.058 | 87.50 | 650 | 0.065 | 86.10 |
| 649 | 0.058 | 87.50 | 649 | 0.065 | 86.10 |
| 648 | 0.059 | 87.30 | 648 | 0.065 | 86.10 |
| 647 | 0.059 | 87.30 | 647 | 0.066 | 85.90 |
| 646 | 0.059 | 87.30 | 646 | 0.066 | 85.90 |
| 645 | 0.06 | 87.10 | 645 | 0.066 | 85.90 |
| 644 | 0.06 | 87.10 | 644 | 0.065 | 86.10 |
| 643 | 0.059 | 87.30 | 643 | 0.065 | 86.10 |
| 642 | 0.059 | 87.30 | 642 | 0.065 | 86.10 |

Table A-4: Continued

| | 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 641 | 0.059 | 87.30 | 641 | 0.065 | 86.10 |
| 640 | 0.059 | 87.30 | 640 | 0.065 | 86.10 |
| 639 | 0.059 | 87.30 | 639 | 0.066 | 85.90 |
| 638 | 0.059 | 87.30 | 638 | 0.066 | 85.90 |
| 637 | 0.059 | 87.30 | 637 | 0.066 | 85.90 |
| 636 | 0.059 | 87.30 | 636 | 0.066 | 85.90 |
| 635 | 0.059 | 87.30 | 635 | 0.066 | 85.90 |
| 634 | 0.059 | 87.30 | 634 | 0.066 | 85.90 |
| 633 | 0.059 | 87.30 | 633 | 0.066 | 85.90 |
| 632 | 0.059 | 87.30 | 632 | 0.066 | 85.90 |
| 631 | 0.059 | 87.30 | 631 | 0.066 | 85.90 |
| 630 | 0.059 | 87.30 | 630 | 0.066 | 85.90 |
| 629 | 0.059 | 87.30 | 629 | 0.066 | 85.90 |
| 628 | 0.06 | 87.10 | 628 | 0.066 | 85.90 |
| 627 | 0.06 | 87.10 | 627 | 0.066 | 85.90 |
| 626 | 0.06 | 87.10 | 626 | 0.066 | 85.90 |
| 625 | 0.06 | 87.10 | 625 | 0.066 | 85.90 |
| 624 | 0.06 | 87.10 | 624 | 0.066 | 85.90 |
| 623 | 0.06 | 87.10 | 623 | 0.066 | 85.90 |
| 622 | 0.06 | 87.10 | 622 | 0.066 | 85.90 |
| 621 | 0.059 | 87.30 | 621 | 0.066 | 85.90 |
| 620 | 0.059 | 87.30 | 620 | 0.066 | 85.90 |
| 619 | 0.06 | 87.10 | 619 | 0.066 | 85.90 |
| 618 | 0.06 | 87.10 | 618 | 0.067 | 85.70 |
| 617 | 0.06 | 87.10 | 617 | 0.067 | 85.70 |
| 616 | 0.06 | 87.10 | 616 | 0.067 | 85.70 |
| 615 | 0.06 | 87.10 | 615 | 0.067 | 85.70 |
| 614 | 0.06 | 87.10 | 614 | 0.067 | 85.70 |
| 613 | 0.06 | 87.10 | 613 | 0.067 | 85.70 |
| 612 | 0.06 | 87.10 | 612 | 0.067 | 85.70 |
| 611 | 0.06 | 87.10 | 611 | 0.067 | 85.70 |
| 610 | 0.06 | 87.10 | 610 | 0.067 | 85.70 |
| 609 | 0.061 | 86.90 | 609 | 0.068 | 85.51 |
| 608 | 0.061 | 86.90 | 608 | 0.068 | 85.51 |
| 607 | 0.061 | 86.90 | 607 | 0.068 | 85.51 |
| 606 | 0.061 | 86.90 | 606 | 0.068 | 85.51 |
| 605 | 0.061 | 86.90 | 605 | 0.067 | 85.70 |
| 604 | 0.06 | 87.10 | 604 | 0.067 | 85.70 |
| 603 | 0.061 | 86.90 | 603 | 0.067 | 85.70 |
| 602 | 0.06 | 87.10 | 602 | 0.067 | 85.70 |
| 601 | 0.06 | 87.10 | 601 | 0.067 | 85.70 |
| 600 | 0.061 | 86.90 | 600 | 0.067 | 85.70 |
| 599 | 0.061 | 86.90 | 599 | 0.067 | 85.70 |
| 598 | 0.061 | 86.90 | 598 | 0.068 | 85.51 |
| 597 | 0.062 | 86.70 | 597 | 0.068 | 85.51 |
| 596 | 0.062 | 86.70 | 596 | 0.068 | 85.51 |
| 595 | 0.062 | 86.70 | 595 | 0.068 | 85.51 |
| 594 | 0.061 | 86.90 | 594 | 0.068 | 85.51 |
| 593 | 0.061 | 86.90 | 593 | 0.068 | 85.51 |
| 592 | 0.061 | 86.90 | 592 | 0.068 | 85.51 |
| 591 | 0.061 | 86.90 | 591 | 0.068 | 85.51 |
| 590 | 0.062 | 86.70 | 590 | 0.068 | 85.51 |
| 589 | 0.062 | 86.70 | 589 | 0.068 | 85.51 |
| 588 | 0.062 | 86.70 | 588 | 0.068 | 85.51 |
| 587 | 0.062 | 86.70 | 587 | 0.068 | 85.51 |
| 586 | 0.062 | 86.70 | 586 | 0.068 | 85.51 |
| 585 | 0.062 | 86.70 | 585 | 0.068 | 85.51 |
| 584 | 0.062 | 86.70 | 584 | 0.068 | 85.51 |
| 583 | 0.062 | 86.70 | 583 | 0.069 | 85.31 |
| 582 | 0.062 | 86.70 | 582 | 0.069 | 85.31 |
| 581 | 0.062 | 86.70 | 581 | 0.069 | 85.31 |
| 580 | 0.062 | 86.70 | 580 | 0.069 | 85.31 |
| 579 | 0.062 | 86.70 | 579 | 0.069 | 85.31 |
| 578 | 0.062 | 86.70 | 578 | 0.069 | 85.31 |

Table A-4: Continued

| 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 577 | 0.063 | 86.50 | 577 | 0.069 | 85.31 |
| 576 | 0.063 | 86.50 | 576 | 0.069 | 85.31 |
| 575 | 0.063 | 86.50 | 575 | 0.069 | 85.31 |
| 574 | 0.063 | 86.50 | 574 | 0.069 | 85.31 |
| 573 | 0.063 | 86.50 | 573 | 0.069 | 85.31 |
| 572 | 0.063 | 86.50 | 572 | 0.069 | 85.31 |
| 571 | 0.064 | 86.30 | 571 | 0.07 | 85.11 |
| 570 | 0.064 | 86.30 | 570 | 0.07 | 85.11 |
| 569 | 0.064 | 86.30 | 569 | 0.07 | 85.11 |
| 568 | 0.064 | 86.30 | 568 | 0.07 | 85.11 |
| 567 | 0.064 | 86.30 | 567 | 0.07 | 85.11 |
| 566 | 0.063 | 86.50 | 566 | 0.07 | 85.11 |
| 565 | 0.063 | 86.50 | 565 | 0.07 | 85.11 |
| 564 | 0.063 | 86.50 | 564 | 0.07 | 85.11 |
| 563 | 0.063 | 86.50 | 563 | 0.07 | 85.11 |
| 562 | 0.064 | 86.30 | 562 | 0.071 | 84.92 |
| 561 | 0.064 | 86.30 | 561 | 0.071 | 84.92 |
| 560 | 0.064 | 86.30 | 560 | 0.07 | 85.11 |
| 559 | 0.064 | 86.30 | 559 | 0.07 | 85.11 |
| 558 | 0.064 | 86.30 | 558 | 0.07 | 85.11 |
| 557 | 0.064 | 86.30 | 557 | 0.07 | 85.11 |
| 556 | 0.064 | 86.30 | 556 | 0.07 | 85.11 |
| 555 | 0.064 | 86.30 | 555 | 0.07 | 85.11 |
| 554 | 0.064 | 86.30 | 554 | 0.071 | 84.92 |
| 553 | 0.064 | 86.30 | 553 | 0.071 | 84.92 |
| 552 | 0.064 | 86.30 | 552 | 0.071 | 84.92 |
| 551 | 0.064 | 86.30 | 551 | 0.07 | 85.11 |
| 550 | 0.064 | 86.30 | 550 | 0.07 | 85.11 |
| 549 | 0.064 | 86.30 | 549 | 0.07 | 85.11 |
| 548 | 0.064 | 86.30 | 548 | 0.07 | 85.11 |
| 547 | 0.064 | 86.30 | 547 | 0.071 | 84.92 |
| 546 | 0.064 | 86.30 | 546 | 0.071 | 84.92 |
| 545 | 0.065 | 86.10 | 545 | 0.071 | 84.92 |
| 544 | 0.065 | 86.10 | 544 | 0.072 | 84.72 |
| 543 | 0.065 | 86.10 | 543 | 0.072 | 84.72 |
| 542 | 0.066 | 85.90 | 542 | 0.072 | 84.72 |
| 541 | 0.066 | 85.90 | 541 | 0.072 | 84.72 |
| 540 | 0.066 | 85.90 | 540 | 0.072 | 84.72 |
| 539 | 0.066 | 85.90 | 539 | 0.072 | 84.72 |
| 538 | 0.066 | 85.90 | 538 | 0.072 | 84.72 |
| 537 | 0.066 | 85.90 | 537 | 0.072 | 84.72 |
| 536 | 0.066 | 85.90 | 536 | 0.072 | 84.72 |
| 535 | 0.065 | 86.10 | 535 | 0.072 | 84.72 |
| 534 | 0.066 | 85.90 | 534 | 0.072 | 84.72 |
| 533 | 0.065 | 86.10 | 533 | 0.072 | 84.72 |
| 532 | 0.066 | 85.90 | 532 | 0.072 | 84.72 |
| 531 | 0.066 | 85.90 | 531 | 0.073 | 84.53 |
| 530 | 0.066 | 85.90 | 530 | 0.073 | 84.53 |
| 529 | 0.066 | 85.90 | 529 | 0.073 | 84.53 |
| 528 | 0.066 | 85.90 | 528 | 0.073 | 84.53 |
| 527 | 0.067 | 85.70 | 527 | 0.073 | 84.53 |
| 526 | 0.067 | 85.70 | 526 | 0.073 | 84.53 |
| 525 | 0.067 | 85.70 | 525 | 0.073 | 84.53 |
| 524 | 0.067 | 85.70 | 524 | 0.073 | 84.53 |
| 523 | 0.067 | 85.70 | 523 | 0.073 | 84.53 |
| 522 | 0.067 | 85.70 | 522 | 0.073 | 84.53 |
| 521 | 0.067 | 85.70 | 521 | 0.073 | 84.53 |
| 520 | 0.067 | 85.70 | 520 | 0.073 | 84.53 |
| 519 | 0.067 | 85.70 | 519 | 0.073 | 84.53 |
| 518 | 0.067 | 85.70 | 518 | 0.074 | 84.33 |
| 517 | 0.067 | 85.70 | 517 | 0.074 | 84.33 |
| 516 | 0.067 | 85.70 | 516 | 0.074 | 84.33 |
| 515 | 0.068 | 85.51 | 515 | 0.074 | 84.33 |
| 514 | 0.068 | 85.51 | 514 | 0.074 | 84.33 |

Table A-4: Continued

| 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 513 | 0.068 | 85.51 | 513 | 0.074 | 84.33 |
| 512 | 0.068 | 85.51 | 512 | 0.074 | 84.33 |
| 511 | 0.068 | 85.51 | 511 | 0.074 | 84.33 |
| 510 | 0.068 | 85.51 | 510 | 0.074 | 84.33 |
| 509 | 0.068 | 85.51 | 509 | 0.074 | 84.33 |
| 508 | 0.068 | 85.51 | 508 | 0.074 | 84.33 |
| 507 | 0.068 | 85.51 | 507 | 0.075 | 84.14 |
| 506 | 0.068 | 85.51 | 506 | 0.075 | 84.14 |
| 505 | 0.069 | 85.31 | 505 | 0.075 | 84.14 |
| 504 | 0.069 | 85.31 | 504 | 0.075 | 84.14 |
| 503 | 0.069 | 85.31 | 503 | 0.075 | 84.14 |
| 502 | 0.069 | 85.31 | 502 | 0.076 | 83.95 |
| 501 | 0.069 | 85.31 | 501 | 0.076 | 83.95 |
| 500 | 0.07 | 85.11 | 500 | 0.076 | 83.95 |
| 499 | 0.07 | 85.11 | 499 | 0.076 | 83.95 |
| 498 | 0.07 | 85.11 | 498 | 0.076 | 83.95 |
| 497 | 0.07 | 85.11 | 497 | 0.076 | 83.95 |
| 496 | 0.07 | 85.11 | 496 | 0.076 | 83.95 |
| 495 | 0.07 | 85.11 | 495 | 0.076 | 83.95 |
| 494 | 0.07 | 85.11 | 494 | 0.076 | 83.95 |
| 493 | 0.07 | 85.11 | 493 | 0.076 | 83.95 |
| 492 | 0.07 | 85.11 | 492 | 0.077 | 83.75 |
| 491 | 0.07 | 85.11 | 491 | 0.077 | 83.75 |
| 490 | 0.07 | 85.11 | 490 | 0.077 | 83.75 |
| 489 | 0.07 | 85.11 | 489 | 0.077 | 83.75 |
| 488 | 0.07 | 85.11 | 488 | 0.076 | 83.95 |
| 487 | 0.071 | 84.92 | 487 | 0.077 | 83.75 |
| 486 | 0.071 | 84.92 | 486 | 0.077 | 83.75 |
| 485 | 0.071 | 84.92 | 485 | 0.077 | 83.75 |
| 484 | 0.072 | 84.72 | 484 | 0.077 | 83.75 |
| 483 | 0.072 | 84.72 | 483 | 0.077 | 83.75 |
| 482 | 0.072 | 84.72 | 482 | 0.077 | 83.75 |
| 481 | 0.071 | 84.92 | 481 | 0.077 | 83.75 |
| 480 | 0.071 | 84.92 | 480 | 0.078 | 83.56 |
| 479 | 0.072 | 84.72 | 479 | 0.078 | 83.56 |
| 478 | 0.072 | 84.72 | 478 | 0.078 | 83.56 |
| 477 | 0.072 | 84.72 | 477 | 0.078 | 83.56 |
| 476 | 0.072 | 84.72 | 476 | 0.078 | 83.56 |
| 475 | 0.072 | 84.72 | 475 | 0.078 | 83.56 |
| 474 | 0.072 | 84.72 | 474 | 0.078 | 83.56 |
| 473 | 0.072 | 84.72 | 473 | 0.078 | 83.56 |
| 472 | 0.072 | 84.72 | 472 | 0.078 | 83.56 |
| 471 | 0.072 | 84.72 | 471 | 0.078 | 83.56 |
| 470 | 0.072 | 84.72 | 470 | 0.078 | 83.56 |
| 469 | 0.072 | 84.72 | 469 | 0.079 | 83.37 |
| 468 | 0.073 | 84.53 | 468 | 0.079 | 83.37 |
| 467 | 0.073 | 84.53 | 467 | 0.079 | 83.37 |
| 466 | 0.073 | 84.53 | 466 | 0.079 | 83.37 |
| 465 | 0.073 | 84.53 | 465 | 0.08 | 83.18 |
| 464 | 0.074 | 84.33 | 464 | 0.08 | 83.18 |
| 463 | 0.074 | 84.33 | 463 | 0.08 | 83.18 |
| 462 | 0.074 | 84.33 | 462 | 0.08 | 83.18 |
| 461 | 0.075 | 84.14 | 461 | 0.08 | 83.18 |
| 460 | 0.075 | 84.14 | 460 | 0.08 | 83.18 |
| 459 | 0.074 | 84.33 | 459 | 0.08 | 83.18 |
| 458 | 0.074 | 84.33 | 458 | 0.081 | 82.99 |
| 457 | 0.074 | 84.33 | 457 | 0.081 | 82.99 |
| 456 | 0.074 | 84.33 | 456 | 0.081 | 82.99 |
| 455 | 0.075 | 84.14 | 455 | 0.081 | 82.99 |
| 454 | 0.075 | 84.14 | 454 | 0.081 | 82.99 |
| 453 | 0.075 | 84.14 | 453 | 0.082 | 82.79 |
| 452 | 0.076 | 83.95 | 452 | 0.082 | 82.79 |
| 451 | 0.076 | 83.95 | 451 | 0.082 | 82.79 |
| 450 | 0.076 | 83.95 | 450 | 0.083 | 82.60 |

Table A-4: Continued

| 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 449 | 0.076 | 83.95 | 449 | 0.083 | 82.60 |
| 448 | 0.076 | 83.95 | 448 | 0.083 | 82.60 |
| 447 | 0.076 | 83.95 | 447 | 0.083 | 82.60 |
| 446 | 0.076 | 83.95 | 446 | 0.083 | 82.60 |
| 445 | 0.076 | 83.95 | 445 | 0.083 | 82.60 |
| 444 | 0.076 | 83.95 | 444 | 0.083 | 82.60 |
| 443 | 0.077 | 83.75 | 443 | 0.083 | 82.60 |
| 442 | 0.077 | 83.75 | 442 | 0.084 | 82.41 |
| 441 | 0.077 | 83.75 | 441 | 0.084 | 82.41 |
| 440 | 0.078 | 83.56 | 440 | 0.084 | 82.41 |
| 439 | 0.078 | 83.56 | 439 | 0.084 | 82.41 |
| 438 | 0.078 | 83.56 | 438 | 0.084 | 82.41 |
| 437 | 0.078 | 83.56 | 437 | 0.085 | 82.22 |
| 436 | 0.077 | 83.75 | 436 | 0.084 | 82.41 |
| 435 | 0.077 | 83.75 | 435 | 0.084 | 82.41 |
| 434 | 0.077 | 83.75 | 434 | 0.084 | 82.41 |
| 433 | 0.078 | 83.56 | 433 | 0.085 | 82.22 |
| 432 | 0.078 | 83.56 | 432 | 0.085 | 82.22 |
| 431 | 0.078 | 83.56 | 431 | 0.086 | 82.04 |
| 430 | 0.079 | 83.37 | 430 | 0.087 | 81.85 |
| 429 | 0.08 | 83.18 | 429 | 0.087 | 81.85 |
| 428 | 0.08 | 83.18 | 428 | 0.087 | 81.85 |
| 427 | 0.08 | 83.18 | 427 | 0.088 | 81.66 |
| 426 | 0.081 | 82.99 | 426 | 0.088 | 81.66 |
| 425 | 0.081 | 82.99 | 425 | 0.088 | 81.66 |
| 424 | 0.081 | 82.99 | 424 | 0.088 | 81.66 |
| 423 | 0.081 | 82.99 | 423 | 0.088 | 81.66 |
| 422 | 0.081 | 82.99 | 422 | 0.088 | 81.66 |
| 421 | 0.081 | 82.99 | 421 | 0.089 | 81.47 |
| 420 | 0.082 | 82.79 | 420 | 0.089 | 81.47 |
| 419 | 0.082 | 82.79 | 419 | 0.09 | 81.28 |
| 418 | 0.082 | 82.79 | 418 | 0.09 | 81.28 |
| 417 | 0.082 | 82.79 | 417 | 0.09 | 81.28 |
| 416 | 0.083 | 82.60 | 416 | 0.09 | 81.28 |
| 415 | 0.083 | 82.60 | 415 | 0.09 | 81.28 |
| 414 | 0.083 | 82.60 | 414 | 0.09 | 81.28 |
| 413 | 0.083 | 82.60 | 413 | 0.09 | 81.28 |
| 412 | 0.083 | 82.60 | 412 | 0.09 | 81.28 |
| 411 | 0.084 | 82.41 | 411 | 0.091 | 81.10 |
| 410 | 0.084 | 82.41 | 410 | 0.091 | 81.10 |
| 409 | 0.085 | 82.22 | 409 | 0.091 | 81.10 |
| 408 | 0.085 | 82.22 | 408 | 0.091 | 81.10 |
| 407 | 0.085 | 82.22 | 407 | 0.092 | 80.91 |
| 406 | 0.086 | 82.04 | 406 | 0.092 | 80.91 |
| 405 | 0.086 | 82.04 | 405 | 0.093 | 80.72 |
| 404 | 0.086 | 82.04 | 404 | 0.093 | 80.72 |
| 403 | 0.087 | 81.85 | 403 | 0.094 | 80.54 |
| 402 | 0.087 | 81.85 | 402 | 0.095 | 80.35 |
| 401 | 0.088 | 81.66 | 401 | 0.096 | 80.17 |
| 400 | 0.088 | 81.66 | 400 | 0.096 | 80.17 |
| 399 | 0.089 | 81.47 | 399 | 0.097 | 79.98 |
| 398 | 0.089 | 81.47 | 398 | 0.097 | 79.98 |
| 397 | 0.088 | 81.66 | 397 | 0.097 | 79.98 |
| 396 | 0.088 | 81.66 | 396 | 0.097 | 79.98 |
| 395 | 0.088 | 81.66 | 395 | 0.097 | 79.98 |
| 394 | 0.089 | 81.47 | 394 | 0.097 | 79.98 |
| 393 | 0.089 | 81.47 | 393 | 0.097 | 79.98 |
| 392 | 0.089 | 81.47 | 392 | 0.097 | 79.98 |
| 391 | 0.089 | 81.47 | 391 | 0.098 | 79.80 |
| 390 | 0.09 | 81.28 | 390 | 0.098 | 79.80 |
| 389 | 0.091 | 81.10 | 389 | 0.098 | 79.80 |
| 388 | 0.091 | 81.10 | 388 | 0.099 | 79.62 |
| 387 | 0.092 | 80.91 | 387 | 0.099 | 79.62 |
| 386 | 0.092 | 80.91 | 386 | 0.1 | 79.43 |

Table A-4: Continued

| 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 385 | 0.093 | 80.72 | 385 | 0.101 | 79.25 |
| 384 | 0.093 | 80.72 | 384 | 0.102 | 79.07 |
| 383 | 0.093 | 80.72 | 383 | 0.102 | 79.07 |
| 382 | 0.093 | 80.72 | 382 | 0.102 | 79.07 |
| 381 | 0.093 | 80.72 | 381 | 0.102 | 79.07 |
| 380 | 0.094 | 80.54 | 380 | 0.103 | 78.89 |
| 379 | 0.094 | 80.54 | 379 | 0.103 | 78.89 |
| 378 | 0.095 | 80.35 | 378 | 0.103 | 78.89 |
| 377 | 0.095 | 80.35 | 377 | 0.103 | 78.89 |
| 376 | 0.095 | 80.35 | 376 | 0.103 | 78.89 |
| 375 | 0.095 | 80.35 | 375 | 0.104 | 78.70 |
| 374 | 0.096 | 80.17 | 374 | 0.105 | 78.52 |
| 373 | 0.096 | 80.17 | 373 | 0.106 | 78.34 |
| 372 | 0.097 | 79.98 | 372 | 0.107 | 78.16 |
| 371 | 0.098 | 79.80 | 371 | 0.107 | 78.16 |
| 370 | 0.098 | 79.80 | 370 | 0.108 | 77.98 |
| 369 | 0.099 | 79.62 | 369 | 0.108 | 77.98 |
| 368 | 0.099 | 79.62 | 368 | 0.108 | 77.98 |
| 367 | 0.099 | 79.62 | 367 | 0.109 | 77.80 |
| 366 | 0.099 | 79.62 | 366 | 0.109 | 77.80 |
| 365 | 0.099 | 79.62 | 365 | 0.109 | 77.80 |
| 364 | 0.1 | 79.43 | 364 | 0.109 | 77.80 |
| 363 | 0.1 | 79.43 | 363 | 0.11 | 77.62 |
| 362 | 0.101 | 79.25 | 362 | 0.111 | 77.45 |
| 361 | 0.101 | 79.25 | 361 | 0.112 | 77.27 |
| 360 | 0.102 | 79.07 | 360 | 0.114 | 76.91 |
| 359 | 0.103 | 78.89 | 359 | 0.116 | 76.56 |
| 358 | 0.104 | 78.70 | 358 | 0.117 | 76.38 |
| 357 | 0.104 | 78.70 | 357 | 0.118 | 76.21 |
| 356 | 0.104 | 78.70 | 356 | 0.118 | 76.21 |
| 355 | 0.103 | 78.89 | 355 | 0.118 | 76.21 |
| 354 | 0.103 | 78.89 | 354 | 0.118 | 76.21 |
| 353 | 0.104 | 78.70 | 353 | 0.119 | 76.03 |
| 352 | 0.104 | 78.70 | 352 | 0.119 | 76.03 |
| 351 | 0.106 | 78.34 | 351 | 0.122 | 75.51 |
| 350 | 0.107 | 78.16 | 350 | 0.124 | 75.16 |
| 349 | 0.108 | 77.98 | 349 | 0.125 | 74.99 |
| 348 | 0.109 | 77.80 | 348 | 0.126 | 74.82 |
| 347 | 0.109 | 77.80 | 347 | 0.126 | 74.82 |
| 346 | 0.11 | 77.62 | 346 | 0.127 | 74.64 |
| 345 | 0.11 | 77.62 | 345 | 0.128 | 74.47 |
| 344 | 0.111 | 77.45 | 344 | 0.129 | 74.30 |
| 343 | 0.112 | 77.27 | 343 | 0.131 | 73.96 |
| 342 | 0.113 | 77.09 | 342 | 0.133 | 73.62 |
| 341 | 0.111 | 77.45 | 341 | 0.134 | 73.45 |
| 340 | 0.111 | 77.45 | 340 | 0.136 | 73.11 |
| 339 | 0.111 | 77.45 | 339 | 0.138 | 72.78 |
| 338 | 0.112 | 77.27 | 338 | 0.139 | 72.61 |
| 337 | 0.113 | 77.09 | 337 | 0.141 | 72.28 |
| 336 | 0.115 | 76.74 | 336 | 0.144 | 71.78 |
| 335 | 0.115 | 76.74 | 335 | 0.145 | 71.61 |
| 334 | 0.116 | 76.56 | 334 | 0.146 | 71.45 |
| 333 | 0.116 | 76.56 | 333 | 0.146 | 71.45 |
| 332 | 0.117 | 76.38 | 332 | 0.147 | 71.29 |
| 331 | 0.118 | 76.21 | 331 | 0.147 | 71.29 |
| 330 | 0.119 | 76.03 | 330 | 0.149 | 70.96 |
| 329 | 0.121 | 75.68 | 329 | 0.153 | 70.31 |
| 328 | 0.124 | 75.16 | 328 | 0.158 | 69.50 |
| 327 | 0.126 | 74.82 | 327 | 0.161 | 69.02 |
| 326 | 0.127 | 74.64 | 326 | 0.163 | 68.71 |
| 325 | 0.127 | 74.64 | 325 | 0.165 | 68.39 |
| 324 | 0.128 | 74.47 | 324 | 0.165 | 68.39 |
| 323 | 0.129 | 74.30 | 323 | 0.166 | 68.23 |
| 322 | 0.129 | 74.30 | 322 | 0.167 | 68.08 |

Table A-4: Continued

| 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 321 | 0.128 | 74.47 | 321 | 0.168 | 67.92 |
| 320 | 0.128 | 74.47 | 320 | 0.17 | 67.61 |
| 319 | 0.128 | 74.47 | 319 | 0.173 | 67.14 |
| 318 | 0.129 | 74.30 | 318 | 0.176 | 66.68 |
| 317 | 0.131 | 73.96 | 317 | 0.177 | 66.53 |
| 316 | 0.131 | 73.96 | 316 | 0.177 | 66.53 |
| 315 | 0.132 | 73.79 | 315 | 0.179 | 66.22 |
| 314 | 0.132 | 73.79 | 314 | 0.181 | 65.92 |
| 313 | 0.133 | 73.62 | 313 | 0.184 | 65.46 |
| 312 | 0.134 | 73.45 | 312 | 0.187 | 65.01 |
| 311 | 0.135 | 73.28 | 311 | 0.192 | 64.27 |
| 310 | 0.136 | 73.11 | 310 | 0.196 | 63.68 |
| 309 | 0.137 | 72.95 | 309 | 0.2 | 63.10 |
| 308 | 0.139 | 72.61 | 308 | 0.204 | 62.52 |
| 307 | 0.14 | 72.44 | 307 | 0.208 | 61.94 |
| 306 | 0.142 | 72.11 | 306 | 0.212 | 61.38 |
| 305 | 0.144 | 71.78 | 305 | 0.216 | 60.81 |
| 304 | 0.147 | 71.29 | 304 | 0.219 | 60.39 |
| 303 | 0.151 | 70.63 | 303 | 0.223 | 59.84 |
| 302 | 0.154 | 70.15 | 302 | 0.228 | 59.16 |
| 301 | 0.156 | 69.82 | 301 | 0.233 | 58.48 |
| 300 | 0.158 | 69.50 | 300 | 0.239 | 57.68 |
| 299 | 0.159 | 69.34 | 299 | 0.245 | 56.89 |
| 298 | 0.16 | 69.18 | 298 | 0.25 | 56.23 |
| 297 | 0.163 | 68.71 | 297 | 0.257 | 55.34 |
| 296 | 0.166 | 68.23 | 296 | 0.263 | 54.58 |
| 295 | 0.167 | 68.08 | 295 | 0.269 | 53.83 |
| 294 | 0.17 | 67.61 | 294 | 0.276 | 52.97 |
| 293 | 0.172 | 67.30 | 293 | 0.283 | 52.12 |
| 292 | 0.175 | 66.83 | 292 | 0.293 | 50.93 |
| 291 | 0.179 | 66.22 | 291 | 0.302 | 49.89 |
| 290 | 0.182 | 65.77 | 290 | 0.309 | 49.09 |
| 289 | 0.186 | 65.16 | 289 | 0.318 | 48.08 |
| 288 | 0.189 | 64.71 | 288 | 0.328 | 46.99 |
| 287 | 0.193 | 64.12 | 287 | 0.337 | 46.03 |
| 286 | 0.197 | 63.53 | 286 | 0.348 | 44.87 |
| 285 | 0.2 | 63.10 | 285 | 0.36 | 43.65 |
| 284 | 0.205 | 62.37 | 284 | 0.372 | 42.46 |
| 283 | 0.21 | 61.66 | 283 | 0.385 | 41.21 |
| 282 | 0.215 | 60.95 | 282 | 0.397 | 40.09 |
| 281 | 0.219 | 60.39 | 281 | 0.409 | 38.99 |
| 280 | 0.222 | 59.98 | 280 | 0.42 | 38.02 |
| 279 | 0.226 | 59.43 | 279 | 0.433 | 36.90 |
| 278 | 0.229 | 59.02 | 278 | 0.446 | 35.81 |
| 277 | 0.234 | 58.34 | 277 | 0.461 | 34.59 |
| 276 | 0.239 | 57.68 | 276 | 0.474 | 33.57 |
| 275 | 0.245 | 56.89 | 275 | 0.49 | 32.36 |
| 274 | 0.251 | 56.10 | 274 | 0.506 | 31.19 |
| 273 | 0.257 | 55.34 | 273 | 0.522 | 30.06 |
| 272 | 0.264 | 54.45 | 272 | 0.54 | 28.84 |
| 271 | 0.272 | 53.46 | 271 | 0.558 | 27.67 |
| 270 | 0.278 | 52.72 | 270 | 0.577 | 26.49 |
| 269 | 0.285 | 51.88 | 269 | 0.599 | 25.18 |
| 268 | 0.293 | 50.93 | 268 | 0.622 | 23.88 |
| 267 | 0.302 | 49.89 | 267 | 0.646 | 22.59 |
| 266 | 0.31 | 48.98 | 266 | 0.669 | 21.43 |
| 265 | 0.32 | 47.86 | 265 | 0.693 | 20.28 |
| 264 | 0.331 | 46.67 | 264 | 0.718 | 19.14 |
| 263 | 0.343 | 45.39 | 263 | 0.744 | 18.03 |
| 262 | 0.358 | 43.85 | 262 | 0.77 | 16.98 |
| 261 | 0.374 | 42.27 | 261 | 0.799 | 15.89 |
| 260 | 0.392 | 40.55 | 260 | 0.831 | 14.76 |
| 259 | 0.413 | 38.64 | 259 | 0.866 | 13.61 |
| 258 | 0.439 | 36.39 | 258 | 0.911 | 12.27 |

Table A-4: Continued

| 10wt% ZrP in PMMA | | | 30wt% ZrP in PMMA | | |
|---|---|---|---|---|---|
| wavelength (nm) | Absorbance | Transmittance (%) | wavelength (nm) | Absorbance | Transmittance (%) |
| 254 | 0.598 | 25.23 | 254 | 1.142 | 7.21 |
| 253 | 0.67 | 21.38 | 253 | 1.229 | 5.90 |
| 252 | 0.751 | 17.74 | 252 | 1.323 | 4.75 |
| 251 | 0.839 | 14.49 | 251 | 1.421 | 3.79 |
| 250 | 0.921 | 11.99 | 250 | 1.517 | 3.04 |

Table A-5: Film Thickness Used for Corrected Absorbance

| ZrP Loading (wt%) | Film Thickness (microns, ±microns) |
|---|---|
| 0 | 210 |
| 5 | 180 |
| 10 | 233.7 |
| 30 | 233.7 |

Table A-6: XRD Data for PMMA, 5wt%, 10wt%, and 30wt% ZrP in PMMA

| Pure PMMA | | 5wt% ZrP in PMMA | | 10wt% ZrP in PMMA | | 30wt% ZrP in PMMA | |
|---|---|---|---|---|---|---|---|
| 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) |
| 5.163466 | 1347 | 5.1635 | 3456 | 5.1635 | 5727 | 5.1635 | 8314 |
| 6.326932 | 1259 | 6.3269 | 3395 | 6.3269 | 5674 | 6.3269 | 8229 |
| 7.490398 | 1336 | 7.4904 | 3508 | 7.4904 | 5803 | 7.4904 | 8200 |
| 8.653864 | 1459 | 8.6539 | 3629 | 8.6539 | 6026 | 8.6539 | 8472 |
| 9.81733 | 1485 | 9.8173 | 3629 | 9.8173 | 5851 | 9.8173 | 8279 |
| 10.980796 | 1719 | 10.9808 | 3846 | 10.9808 | 5937 | 10.9808 | 8312 |
| 12.144262 | 1977 | 12.1443 | 4196 | 12.1443 | 6251 | 12.1443 | 8413 |
| 13.307728 | 2246 | 13.3077 | 4394 | 13.3077 | 6478 | 13.3077 | 8503 |
| 14.471194 | 2256 | 14.4712 | 4514 | 14.4712 | 6916 | 14.4712 | 8448 |
| 15.63466 | 2242 | 15.6347 | 4362 | 15.6347 | 6452 | 15.6347 | 8445 |
| 16.798126 | 2159 | 16.7981 | 4244 | 16.7981 | 6437 | 16.7981 | 8471 |
| 17.961592 | 2018 | 17.9616 | 4186 | 17.9616 | 6391 | 17.9616 | 8454 |
| 19.125058 | 1925 | 19.1251 | 4182 | 19.1251 | 6334 | 19.1251 | 8599 |
| 20.288524 | 1854 | 20.2885 | 4173 | 20.2885 | 6310 | 20.2885 | 8600 |
| 21.45199 | 1906 | 21.452 | 4142 | 21.452 | 6614 | 21.452 | 8674 |
| 22.615456 | 1554 | 22.6155 | 4000 | 22.6155 | 6070 | 22.6155 | 9041 |
| 23.778922 | 1435 | 23.7789 | 3746 | 23.7789 | 6019 | 23.7789 | 8312 |
| 24.942388 | 1268 | 24.9424 | 3554 | 24.9424 | 5813 | 24.9424 | 8213 |
| 26.105854 | 1157 | 26.1059 | 3439 | 26.1059 | 5841 | 26.1059 | 8126 |
| 27.26932 | 1096 | 27.2693 | 3418 | 27.2693 | 5642 | 27.2693 | 8296 |
| 28.432786 | 1079 | 28.4328 | 3374 | 28.4328 | 5564 | 28.4328 | 7916 |
| 29.596252 | 1101 | 29.5963 | 3341 | 29.5963 | 5520 | 29.5963 | 7936 |
| 30.759718 | 952 | 30.7597 | 3296 | 30.7597 | 5472 | 30.7597 | 7828 |
| 31.923184 | 895 | 31.9232 | 3197 | 31.9232 | 5374 | 31.9232 | 7798 |
| 33.08665 | 915 | 33.0866 | 3188 | 33.0866 | 5385 | 33.0866 | 8095 |
| 34.250116 | 719 | 34.2501 | 2999 | 34.2501 | 5399 | 34.2501 | 7931 |
| 35.413582 | 710 | 35.4136 | 2925 | 35.4136 | 5176 | 35.4136 | 7686 |
| 36.577048 | 596 | 36.577 | 2958 | 36.577 | 5152 | 36.577 | 7607 |
| 37.740514 | 555 | 37.7405 | 2858 | 37.7405 | 5104 | 37.7405 | 7665 |
| 38.90398 | 543 | 38.904 | 2855 | 38.904 | 5061 | 38.904 | 7566 |
| 13.4624 | 7457 | 14.1676 | 10945 | 13.4624 | 14305 | 13.4624 | 14351 |
| 13.7354 | 7292 | 14.4634 | 10648 | 13.7354 | 14320 | 13.7354 | 14560 |
| 14.0084 | 7391 | 14.7591 | 10475 | 14.0084 | 14217 | 14.0084 | 14553 |
| 14.2814 | 7327 | 15.0548 | 10308 | 14.2814 | 14325 | 14.2814 | 14551 |
| 14.5544 | 7171 | 15.3506 | 9989 | 14.5544 | 14051 | 14.5544 | 14653 |
| 14.8274 | 6921 | 15.6463 | 9886 | 14.8274 | 13969 | 14.8274 | 14552 |
| 15.1003 | 6833 | 15.942 | 9401 | 15.1003 | 13758 | 15.1003 | 14322 |
| 15.3733 | 6870 | 16.2377 | 9216 | 15.3733 | 13651 | 15.3733 | 14383 |
| 15.6463 | 6595 | 16.5335 | 9094 | 15.6463 | 13341 | 15.6463 | 14406 |
| 15.9193 | 6449 | 16.8292 | 8789 | 15.9193 | 13182 | 15.9193 | 14388 |
| 16.1923 | 6441 | 17.1249 | 8580 | 16.1923 | 13025 | 16.1923 | 14122 |
| 16.4652 | 6393 | 17.4207 | 8462 | 16.4652 | 12940 | 16.4652 | 13819 |
| 16.7382 | 6136 | 17.7164 | 8141 | 16.7382 | 12516 | 16.7382 | 13885 |
| 17.0112 | 5896 | 18.0121 | 7948 | 17.0112 | 12293 | 17.0112 | 13712 |
| 17.2842 | 5756 | 18.3079 | 7773 | 17.2842 | 12091 | 17.2842 | 13668 |
| 17.5572 | 5754 | 18.6036 | 7485 | 17.5572 | 12067 | 17.5572 | 13574 |
| 17.8302 | 5514 | 18.8993 | 7349 | 17.8302 | 11666 | 17.8302 | 13440 |
| 18.1031 | 5520 | 19.195 | 7148 | 18.1031 | 11621 | 18.1031 | 13374 |
| 18.3761 | 5213 | 19.4908 | 6973 | 18.3761 | 11198 | 18.3761 | 13248 |
| 18.6491 | 5063 | 19.7865 | 6955 | 18.6491 | 11072 | 18.6491 | 13060 |
| 18.9221 | 5017 | 20.0822 | 6631 | 18.9221 | 11091 | 18.9221 | 12833 |
| 19.1951 | 4720 | 20.378 | 6467 | 19.1951 | 10790 | 19.1951 | 12704 |
| 19.468 | 4585 | 20.6737 | 6307 | 19.468 | 10516 | 19.468 | 12640 |
| 19.741 | 4539 | 20.9694 | 6217 | 19.741 | 10331 | 19.741 | 12424 |
| 20.014 | 4470 | 21.2651 | 5977 | 20.014 | 10122 | 20.014 | 12447 |
| 20.287 | 4226 | 21.5609 | 6001 | 20.287 | 9940 | 20.287 | 12309 |
| 20.56 | 4113 | 21.8566 | 5864 | 20.56 | 9777 | 20.56 | 12041 |
| 20.833 | 4018 | 22.1523 | 5771 | 20.833 | 9645 | 20.833 | 12064 |
| 21.1059 | 3804 | 22.4481 | 5838 | 21.1059 | 9420 | 21.1059 | 11905 |
| 21.3789 | 3747 | 22.7438 | 5677 | 21.3789 | 9298 | 21.3789 | 11774 |
| 21.6519 | 3527 | 23.0395 | 5613 | 21.6519 | 9286 | 21.6519 | 11774 |
| 21.9249 | 3627 | 23.3353 | 5534 | 21.9249 | 9183 | 21.9249 | 11606 |
| 22.1979 | 3517 | 23.631 | 5475 | 22.1979 | 9039 | 22.1979 | 11503 |
| 22.4708 | 3440 | 23.9267 | 5443 | 22.4708 | 8864 | 22.4708 | 11456 |
| 22.7438 | 3446 | 24.2224 | 5402 | 22.7438 | 8871 | 22.7438 | 11377 |
| 23.0168 | 3330 | 24.5182 | 5509 | 23.0168 | 8744 | 23.0168 | 11380 |
| 23.2898 | 3323 | 24.8139 | 5429 | 23.2898 | 8845 | 23.2898 | 11217 |

Table A-6: Continued

| Pure PMMA | | 5wt% ZrP in PMMA | | 10wt% ZrP in PMMA | | 30wt% ZrP in PMMA | |
|---|---|---|---|---|---|---|---|
| 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) |
| 23.5628 | 3356 | 25.1096 | 5552 | 23.5628 | 8689 | 23.5628 | 11176 |
| 23.8358 | 3322 | 25.4054 | 5557 | 23.8358 | 8670 | 23.8358 | 11208 |
| 24.1087 | 3250 | 25.7011 | 5646 | 24.1087 | 8538 | 24.1087 | 11040 |
| 24.3817 | 3513 | 25.9968 | 5722 | 24.3817 | 8598 | 24.3817 | 11213 |
| 24.6547 | 3358 | 26.2926 | 5816 | 24.6547 | 8622 | 24.6547 | 11013 |
| 24.9277 | 3393 | 26.5883 | 5779 | 24.9277 | 8596 | 24.9277 | 11194 |
| 25.2007 | 3473 | 26.884 | 5854 | 25.2007 | 8713 | 25.2007 | 11053 |
| 25.4737 | 3567 | 27.1797 | 5924 | 25.4737 | 8543 | 25.4737 | 11163 |
| 25.7466 | 3613 | 27.4755 | 6088 | 25.7466 | 8694 | 25.7466 | 11197 |
| 26.0196 | 3586 | 27.7712 | 6033 | 26.0196 | 8715 | 26.0196 | 11206 |
| 26.2926 | 3615 | 28.0669 | 6185 | 26.2926 | 8718 | 26.2926 | 11314 |
| 26.5656 | 3620 | 28.3627 | 6143 | 26.5656 | 8777 | 26.5656 | 11340 |
| 26.8386 | 3872 | 28.6584 | 6183 | 26.8386 | 8881 | 26.8386 | 11346 |
| 27.1115 | 3932 | 28.9541 | 6130 | 27.1115 | 8912 | 27.1115 | 11404 |
| 27.3845 | 3932 | 29.2499 | 6458 | 27.3845 | 9013 | 27.3845 | 11546 |
| 27.6575 | 4009 | 29.5456 | 6366 | 27.6575 | 9110 | 27.6575 | 11372 |
| 27.9305 | 4004 | 29.8413 | 6327 | 27.9305 | 9309 | 27.9305 | 11654 |
| 28.2035 | 4112 | 30.137 | 6374 | 28.2035 | 9181 | 28.2035 | 11601 |
| 28.4765 | 4149 | 30.4328 | 6464 | 28.4765 | 9406 | 28.4765 | 11669 |
| 28.7494 | 4272 | 30.7285 | 6199 | 28.7494 | 9395 | 28.7494 | 11783 |
| 29.0224 | 4295 | 31.0242 | 6198 | 29.0224 | 9327 | 29.0224 | 11851 |
| 29.2954 | 4414 | 31.32 | 6344 | 29.2954 | 9430 | 29.2954 | 11799 |
| 29.5684 | 4212 | 31.6157 | 6243 | 29.5684 | 9386 | 29.5684 | 11857 |
| 29.8414 | 4355 | 31.9114 | 6205 | 29.8414 | 9462 | 29.8414 | 11818 |
| 30.1143 | 4385 | 32.2072 | 6111 | 30.1143 | 9432 | 30.1143 | 11688 |
| 30.3873 | 4325 | 32.5029 | 6067 | 30.3873 | 9483 | 30.3873 | 11873 |
| 30.6603 | 4411 | 32.7986 | 6028 | 30.6603 | 9434 | 30.6603 | 11736 |
| 30.9333 | 4619 | 33.0943 | 6015 | 30.9333 | 9360 | 30.9333 | 11793 |
| 31.2063 | 4479 | 33.3901 | 6059 | 31.2063 | 9287 | 31.2063 | 11839 |
| 31.4793 | 4365 | 33.6858 | 5892 | 31.4793 | 9418 | 31.4793 | 11796 |
| 31.7522 | 4349 | 33.9815 | 5878 | 31.7522 | 9381 | 31.7522 | 11712 |
| 32.0252 | 4413 | 34.2773 | 5791 | 32.0252 | 9336 | 32.0252 | 11678 |
| 32.2982 | 4259 | 34.573 | 5757 | 32.2982 | 9154 | 32.2982 | 11551 |
| 32.5712 | 4180 | 34.8687 | 5685 | 32.5712 | 9169 | 32.5712 | 11566 |
| 32.8442 | 4133 | 35.1645 | 5682 | 32.8442 | 9145 | 32.8442 | 11509 |
| 33.1171 | 4153 | 35.4602 | 5563 | 33.1171 | 9047 | 33.1171 | 11523 |
| 33.3901 | 4113 | 35.7559 | 5650 | 33.3901 | 8960 | 33.3901 | 11436 |
| 33.6631 | 4078 | 36.0516 | 5608 | 33.6631 | 8921 | 33.6631 | 11453 |
| 33.9361 | 3998 | 36.3474 | 5624 | 33.9361 | 8805 | 33.9361 | 11333 |
| 34.2091 | 4040 | 36.6431 | 5655 | 34.2091 | 8893 | 34.2091 | 11200 |
| 34.4821 | 3984 | 36.9388 | 5613 | 34.4821 | 8889 | 34.4821 | 11188 |
| 34.755 | 3861 | 37.2346 | 5349 | 34.755 | 8769 | 34.755 | 11200 |
| 35.028 | 3812 | 37.5303 | 5503 | 35.028 | 8718 | 35.028 | 11288 |
| 35.301 | 3944 | 37.826 | 5427 | 35.301 | 8698 | 35.301 | 11033 |
| 35.574 | 3836 | 38.1218 | 5513 | 35.574 | 8719 | 35.574 | 11080 |
| 35.847 | 3716 | 38.4175 | 5413 | 35.847 | 8489 | 35.847 | 11026 |
| 36.1199 | 3692 | 38.7132 | 5556 | 36.1199 | 8434 | 36.1199 | 11010 |
| 36.3929 | 3655 | 39.0089 | 5444 | 36.3929 | 8370 | 36.3929 | 11003 |
| 36.6659 | 3734 | 39.3047 | 5553 | 36.6659 | 8470 | 36.6659 | 10951 |
| 36.9389 | 3764 | 39.6004 | 5603 | 36.9389 | 8368 | 36.9389 | 10895 |
| 37.2119 | 3485 | 39.8961 | 5563 | 37.2119 | 8409 | 37.2119 | 10964 |
| 37.4849 | 3667 | 40.1919 | 5571 | 37.4849 | 8507 | 37.4849 | 10858 |
| 37.7578 | 3674 | 40.4876 | 5662 | 37.7578 | 8427 | 37.7578 | 10986 |
| 38.0308 | 3615 | 40.7833 | 5619 | 38.0308 | 8230 | 38.0308 | 10979 |
| 38.3038 | 3533 | 41.0791 | 5557 | 38.3038 | 8373 | 38.3038 | 10957 |
| 38.5768 | 3602 | 41.3748 | 5561 | 38.5768 | 8442 | 38.5768 | 10932 |
| 38.8498 | 3554 | 41.6705 | 5492 | 38.8498 | 8301 | 38.8498 | 10759 |
| 39.1228 | 3682 | 41.9662 | 5817 | 39.1228 | 8536 | 39.1228 | 10959 |
| 39.3957 | 3634 | 42.262 | 5771 | 39.3957 | 8440 | 39.3957 | 10967 |
| 39.6687 | 3638 | 42.5577 | 5911 | 39.6687 | 8375 | 39.6687 | 11022 |
| 39.9417 | 3696 | 42.8534 | 6812 | 39.9417 | 8509 | 39.9417 | 10939 |
| 40.2147 | 3723 | 43.1492 | 8963 | 40.2147 | 8388 | 40.2147 | 11035 |
| 40.4877 | 3763 | 43.4449 | 6666 | 40.4877 | 8396 | 40.4877 | 11012 |
| 40.7606 | 3716 | 43.7406 | 6183 | 40.7606 | 8599 | 40.7606 | 10995 |
| 41.0336 | 3762 | 44.0364 | 6138 | 41.0336 | 8522 | 41.0336 | 11051 |
| 41.3066 | 3758 | 44.3321 | 5770 | 41.3066 | 8445 | 41.3066 | 11071 |
| 41.5796 | 3742 | 44.6278 | 5622 | 41.5796 | 8643 | 41.5796 | 10963 |

Table A-6: Continued

| Pure PMMA | | 5wt% ZrP in PMMA | | 10wt% ZrP in PMMA | | 30wt% ZrP in PMMA | |
|---|---|---|---|---|---|---|---|
| 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) |
| 41.8526 | 3712 | 44.9235 | 5461 | 41.8526 | 8689 | 41.8526 | 11168 |
| 42.1256 | 3843 | 45.2193 | 5475 | 42.1256 | 8730 | 42.1256 | 11247 |
| 42.3985 | 4020 | 45.515 | 5375 | 42.3985 | 8702 | 42.3985 | 11385 |
| 42.6715 | 4202 | 45.8107 | 5336 | 42.6715 | 9142 | 42.6715 | 11757 |
| 42.9445 | 5891 | 46.1065 | 5357 | 42.9445 | 10954 | 42.9445 | 13471 |
| 43.2175 | 6878 | 46.4022 | 5346 | 43.2175 | 11957 | 43.2175 | 14204 |
| 43.4905 | 4867 | 46.6979 | 5309 | 43.4905 | 9547 | 43.4905 | 12001 |
| 43.7634 | 4206 | 46.9937 | 5284 | 43.7634 | 9086 | 43.7634 | 11563 |
| 44.0364 | 4081 | 47.2894 | 5268 | 44.0364 | 8944 | 44.0364 | 11557 |
| 44.3094 | 3959 | 47.5851 | 5314 | 44.3094 | 8705 | 44.3094 | 11217 |
| 44.5824 | 3706 | 47.8808 | 5322 | 44.5824 | 8446 | 44.5824 | 10969 |
| 44.8554 | 3671 | 48.1766 | 5279 | 44.8554 | 8362 | 44.8554 | 10865 |
| 45.1284 | 3615 | 48.4723 | 5247 | 45.1284 | 8366 | 45.1284 | 10950 |
| 45.4013 | 3448 | 48.768 | 5290 | 45.4013 | 8280 | 45.4013 | 10687 |
| 45.6743 | 3498 | 49.0638 | 5388 | 45.6743 | 8240 | 45.6743 | 10708 |
| 45.9473 | 3484 | 49.3595 | 5381 | 45.9473 | 8090 | 45.9473 | 10835 |
| 46.2203 | 3425 | 49.6552 | 5570 | 46.2203 | 8181 | 46.2203 | 10742 |
| 46.4933 | 3340 | 49.951 | 5862 | 46.4933 | 8113 | 46.4933 | 10732 |
| 46.7662 | 3243 | 50.2467 | 5948 | 46.7662 | 8224 | 46.7662 | 10737 |
| 47.0392 | 3375 | 50.5424 | 5579 | 47.0392 | 8116 | 47.0392 | 10685 |
| 47.3122 | 3348 | 50.8381 | 5300 | 47.3122 | 8125 | 47.3122 | 10621 |
| 47.5852 | 3373 | 51.1339 | 5277 | 47.5852 | 8100 | 47.5852 | 10712 |
| 47.8582 | 3328 | 51.4296 | 5402 | 47.8582 | 8121 | 47.8582 | 10689 |
| 48.1312 | 3288 | 51.7253 | 5244 | 48.1312 | 8144 | 48.1312 | 10786 |
| 48.4041 | 3393 | 52.0211 | 5274 | 48.4041 | 7997 | 48.4041 | 10653 |
| 48.6771 | 3289 | 52.3168 | 5214 | 48.6771 | 8019 | 48.6771 | 10726 |
| 48.9501 | 3349 | 52.6125 | 5278 | 48.9501 | 8021 | 48.9501 | 10650 |
| 49.2231 | 3420 | 52.9083 | 5142 | 49.2231 | 8148 | 49.2231 | 10730 |
| 49.4961 | 3447 | 53.204 | 5172 | 49.4961 | 8227 | 49.4961 | 10897 |
| 49.769 | 3664 | 53.4997 | 5258 | 49.769 | 8535 | 49.769 | 11056 |
| 50.042 | 4129 | 53.7954 | 5188 | 50.042 | 8884 | 50.042 | 11441 |
| 50.315 | 4051 | 54.0912 | 5242 | 50.315 | 8709 | 50.315 | 11407 |
| 50.588 | 3514 | 54.3869 | 5251 | 50.588 | 8349 | 50.588 | 10845 |
| 50.861 | 3438 | 54.6826 | 5234 | 50.861 | 8079 | 50.861 | 10722 |
| 51.134 | 3278 | 54.9784 | 5201 | 51.134 | 7987 | 51.134 | 10672 |
| 51.4069 | 3190 | 55.2741 | 5089 | 51.4069 | 8016 | 51.4069 | 10631 |
| 51.6799 | 3282 | 55.5698 | 5200 | 51.6799 | 8041 | 51.6799 | 10436 |

# APPENDIX B

# RAW TGA AND DTG DATA USED IN SECTION 5

Table B-1: TGA and DTG for PMMA, 1wt%, and 2wt% silica in PMMA at 10C/min

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 200.0364 | 100.000 | 0.015164 | 200.0340 | 100.000 | 0.017540 | 200.0340 | 100.000 | 0.017540 |
| 201.0355 | 99.985 | 0.014585 | 201.0327 | 99.983 | 0.016988 | 201.0327 | 99.983 | 0.016988 |
| 202.0339 | 99.973 | 0.013774 | 202.0315 | 99.966 | 0.016563 | 202.0315 | 99.966 | 0.016563 |
| 203.0324 | 99.958 | 0.013547 | 203.0315 | 99.951 | 0.016190 | 203.0315 | 99.951 | 0.016190 |
| 204.0326 | 99.945 | 0.013327 | 204.0295 | 99.933 | 0.015951 | 204.0295 | 99.933 | 0.015951 |
| 205.0246 | 99.948 | 0.013164 | 205.0280 | 99.920 | 0.015703 | 205.0280 | 99.920 | 0.015703 |
| 206.0341 | 99.922 | 0.013058 | 206.0291 | 99.903 | 0.015389 | 206.0291 | 99.903 | 0.015389 |
| 207.0293 | 99.909 | 0.013050 | 207.0262 | 99.889 | 0.015183 | 207.0262 | 99.889 | 0.015183 |
| 208.0332 | 99.895 | 0.012883 | 208.0260 | 99.871 | 0.014850 | 208.0260 | 99.871 | 0.014850 |
| 209.0331 | 99.872 | 0.012720 | 209.0232 | 99.856 | 0.014621 | 209.0232 | 99.856 | 0.014621 |
| 210.0324 | 99.869 | 0.013971 | 210.0234 | 99.844 | 0.014489 | 210.0234 | 99.844 | 0.014489 |
| 211.0302 | 99.852 | 0.012690 | 211.0244 | 99.830 | 0.014285 | 211.0244 | 99.830 | 0.014285 |
| 212.0279 | 99.839 | 0.013956 | 212.0298 | 99.815 | 0.014152 | 212.0298 | 99.815 | 0.014152 |
| 213.0294 | 99.832 | 0.012494 | 213.0241 | 99.803 | 0.013991 | 213.0241 | 99.803 | 0.013991 |
| 214.0286 | 99.813 | 0.012871 | 214.0235 | 99.786 | 0.015143 | 214.0235 | 99.786 | 0.015143 |
| 215.0303 | 99.805 | 0.012057 | 215.0250 | 99.774 | 0.013837 | 215.0250 | 99.774 | 0.013837 |
| 216.0304 | 99.794 | 0.011826 | 216.0246 | 99.759 | 0.013679 | 216.0246 | 99.759 | 0.013679 |
| 217.0186 | 99.732 | 0.011991 | 217.0238 | 99.746 | 0.013676 | 217.0238 | 99.746 | 0.013676 |
| 218.0303 | 99.771 | 0.012206 | 218.0244 | 99.732 | 0.013564 | 218.0244 | 99.732 | 0.013564 |
| 219.0223 | 99.689 | 0.012107 | 219.0117 | 99.674 | 0.013315 | 219.0117 | 99.674 | 0.013315 |
| 220.0269 | 99.751 | 0.012357 | 220.0224 | 99.715 | 0.013444 | 220.0224 | 99.715 | 0.013444 |
| 221.0251 | 99.727 | 0.012360 | 221.0185 | 99.690 | 0.013549 | 221.0185 | 99.690 | 0.013549 |
| 222.0278 | 99.716 | 0.013821 | 222.0213 | 99.678 | 0.013932 | 222.0213 | 99.678 | 0.013932 |
| 223.0256 | 99.701 | 0.013349 | 223.0190 | 99.663 | 0.014297 | 223.0190 | 99.663 | 0.014297 |
| 224.0226 | 99.693 | 0.014779 | 224.0185 | 99.652 | 0.015432 | 224.0185 | 99.652 | 0.015432 |
| 225.0241 | 99.677 | 0.014168 | 225.0164 | 99.635 | 0.015414 | 225.0164 | 99.635 | 0.015414 |
| 226.0263 | 99.664 | 0.014260 | 226.0181 | 99.622 | 0.015830 | 226.0181 | 99.622 | 0.015830 |
| 227.0266 | 99.649 | 0.014720 | 227.0165 | 99.601 | 0.016759 | 227.0165 | 99.601 | 0.016759 |
| 228.0235 | 99.632 | 0.015079 | 228.0164 | 99.586 | 0.017686 | 228.0164 | 99.586 | 0.017686 |
| 229.0114 | 99.602 | 0.015681 | 229.0170 | 99.575 | 0.018614 | 229.0170 | 99.575 | 0.018614 |
| 230.0220 | 99.599 | 0.016153 | 230.0164 | 99.549 | 0.019601 | 230.0164 | 99.549 | 0.019601 |
| 231.0215 | 99.585 | 0.016781 | 231.0197 | 99.530 | 0.020534 | 231.0197 | 99.530 | 0.020534 |
| 232.0232 | 99.570 | 0.017588 | 232.0138 | 99.508 | 0.021467 | 232.0138 | 99.508 | 0.021467 |
| 233.0228 | 99.550 | 0.018328 | 233.0138 | 99.492 | 0.022792 | 233.0138 | 99.492 | 0.022792 |
| 234.0226 | 99.530 | 0.020547 | 234.0132 | 99.463 | 0.024304 | 234.0132 | 99.463 | 0.024304 |
| 235.0230 | 99.516 | 0.020485 | 235.0129 | 99.439 | 0.025623 | 235.0129 | 99.439 | 0.025623 |
| 236.0211 | 99.492 | 0.021025 | 236.0136 | 99.416 | 0.027239 | 236.0136 | 99.416 | 0.027239 |
| 237.0215 | 99.469 | 0.023791 | 237.0146 | 99.387 | 0.028646 | 237.0146 | 99.387 | 0.028646 |
| 238.0216 | 99.443 | 0.024665 | 238.0161 | 99.356 | 0.030796 | 238.0161 | 99.356 | 0.030796 |
| 239.0236 | 99.394 | 0.024099 | 239.0125 | 99.323 | 0.032645 | 239.0125 | 99.323 | 0.032645 |
| 240.0208 | 99.431 | 0.024158 | 240.0125 | 99.292 | 0.034689 | 240.0125 | 99.292 | 0.034689 |
| 241.0212 | 99.377 | 0.025282 | 241.0160 | 99.269 | 0.037073 | 241.0160 | 99.269 | 0.037073 |
| 242.0062 | 99.316 | 0.027119 | 242.0129 | 99.215 | 0.039044 | 242.0129 | 99.215 | 0.039044 |
| 243.0050 | 99.317 | 0.028201 | 243.0132 | 99.173 | 0.041440 | 243.0132 | 99.173 | 0.041440 |
| 244.0235 | 99.344 | 0.030325 | 244.0126 | 99.136 | 0.044382 | 244.0126 | 99.136 | 0.044382 |
| 245.0315 | 99.263 | 0.033378 | 245.0132 | 99.089 | 0.047863 | 245.0132 | 99.089 | 0.047863 |
| 246.0283 | 99.222 | 0.034944 | 246.0149 | 99.041 | 0.051938 | 246.0149 | 99.041 | 0.051938 |
| 247.0262 | 99.213 | 0.039191 | 247.0142 | 98.991 | 0.055202 | 247.0142 | 98.991 | 0.055202 |
| 248.0280 | 99.149 | 0.043113 | 248.0182 | 98.929 | 0.059754 | 248.0182 | 98.929 | 0.059754 |
| 249.0228 | 99.100 | 0.046257 | 249.0150 | 98.869 | 0.063988 | 249.0150 | 98.869 | 0.063988 |
| 250.0204 | 99.060 | 0.047402 | 250.0159 | 98.806 | 0.068451 | 250.0159 | 98.806 | 0.068451 |
| 251.0184 | 99.010 | 0.050678 | 251.0160 | 98.733 | 0.073813 | 251.0160 | 98.733 | 0.073813 |
| 252.0158 | 98.956 | 0.055639 | 252.0148 | 98.656 | 0.079577 | 252.0148 | 98.656 | 0.079577 |
| 253.0154 | 98.905 | 0.059387 | 253.0175 | 98.576 | 0.085709 | 253.0175 | 98.576 | 0.085709 |
| 254.0108 | 98.787 | 0.064549 | 254.0161 | 98.498 | 0.093113 | 254.0161 | 98.498 | 0.093113 |
| 255.0165 | 98.790 | 0.070378 | 255.0207 | 98.400 | 0.102517 | 255.0207 | 98.400 | 0.102517 |
| 256.0138 | 98.708 | 0.076698 | 256.0238 | 98.296 | 0.110859 | 256.0238 | 98.296 | 0.110859 |

Table B-1: Continued

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 257.0124 | 98.626 | 0.083676 | 257.0274 | 98.179 | 0.121283 | 257.0274 | 98.179 | 0.121283 |
| 258.0148 | 98.540 | 0.092115 | 258.0258 | 98.052 | 0.133187 | 258.0258 | 98.052 | 0.133187 |
| 259.0170 | 98.446 | 0.100902 | 259.0258 | 97.921 | 0.146556 | 259.0258 | 97.921 | 0.146556 |
| 260.0146 | 98.342 | 0.112068 | 260.0230 | 97.772 | 0.161993 | 260.0230 | 97.772 | 0.161993 |
| 261.0226 | 98.231 | 0.121785 | 261.0326 | 97.610 | 0.177477 | 261.0326 | 97.610 | 0.177477 |
| 262.0234 | 98.102 | 0.133827 | 262.0418 | 97.427 | 0.196326 | 262.0418 | 97.427 | 0.196326 |
| 263.0268 | 97.968 | 0.147239 | 263.0454 | 97.222 | 0.217262 | 263.0454 | 97.222 | 0.217262 |
| 264.0264 | 97.816 | 0.161681 | 264.0488 | 96.998 | 0.240592 | 264.0488 | 96.998 | 0.240592 |
| 265.0292 | 97.698 | 0.177440 | 265.0556 | 96.800 | 0.267442 | 265.0556 | 96.800 | 0.267442 |
| 266.0322 | 97.463 | 0.194237 | 266.0600 | 96.475 | 0.294358 | 266.0600 | 96.475 | 0.294358 |
| 267.0371 | 97.260 | 0.212275 | 267.0658 | 96.165 | 0.324175 | 267.0658 | 96.165 | 0.324175 |
| 268.0400 | 97.044 | 0.231974 | 268.0713 | 95.829 | 0.356056 | 268.0713 | 95.829 | 0.356056 |
| 269.0460 | 96.803 | 0.251778 | 269.0779 | 95.459 | 0.389336 | 269.0779 | 95.459 | 0.389336 |
| 270.0494 | 96.542 | 0.275547 | 270.0770 | 95.050 | 0.425468 | 270.0770 | 95.050 | 0.425468 |
| 271.0539 | 96.261 | 0.297470 | 271.0836 | 94.609 | 0.459557 | 271.0836 | 94.609 | 0.459557 |
| 272.0584 | 95.941 | 0.321999 | 272.0841 | 94.131 | 0.495639 | 272.0841 | 94.131 | 0.495639 |
| 273.0618 | 95.612 | 0.347816 | 273.0900 | 93.614 | 0.531071 | 273.0900 | 93.614 | 0.531071 |
| 274.0719 | 95.257 | 0.374553 | 274.0925 | 93.066 | 0.566282 | 274.0925 | 93.066 | 0.566282 |
| 275.0735 | 94.864 | 0.402442 | 275.0975 | 92.474 | 0.601154 | 275.0975 | 92.474 | 0.601154 |
| 276.0756 | 94.452 | 0.432458 | 276.0994 | 91.852 | 0.634837 | 276.0994 | 91.852 | 0.634837 |
| 277.0800 | 94.003 | 0.463769 | 277.1062 | 91.216 | 0.668182 | 277.1062 | 91.216 | 0.668182 |
| 278.0800 | 93.531 | 0.496836 | 278.1070 | 90.506 | 0.698734 | 278.1070 | 90.506 | 0.698734 |
| 279.0825 | 93.022 | 0.530971 | 279.1083 | 89.787 | 0.727249 | 279.1083 | 89.787 | 0.727249 |
| 280.0896 | 92.478 | 0.568768 | 280.1039 | 89.037 | 0.753845 | 280.1039 | 89.037 | 0.753845 |
| 281.0884 | 91.889 | 0.606771 | 281.1037 | 88.268 | 0.778349 | 281.1037 | 88.268 | 0.778349 |
| 282.0875 | 91.270 | 0.644910 | 282.1015 | 87.477 | 0.800153 | 282.1015 | 87.477 | 0.800153 |
| 283.0919 | 90.613 | 0.684843 | 283.0988 | 86.663 | 0.819645 | 283.0988 | 86.663 | 0.819645 |
| 284.0907 | 89.900 | 0.724694 | 284.0958 | 85.832 | 0.839386 | 284.0958 | 85.832 | 0.839386 |
| 285.0876 | 89.157 | 0.762993 | 285.0930 | 84.976 | 0.858735 | 285.0930 | 84.976 | 0.858735 |
| 286.0835 | 88.367 | 0.805059 | 286.0920 | 84.121 | 0.876922 | 286.0920 | 84.121 | 0.876922 |
| 287.0851 | 87.562 | 0.847519 | 287.0884 | 83.247 | 0.896360 | 287.0884 | 83.247 | 0.896360 |
| 288.0836 | 86.697 | 0.890985 | 288.0872 | 82.340 | 0.915642 | 288.0872 | 82.340 | 0.915642 |
| 289.0799 | 85.798 | 0.935502 | 289.0783 | 81.415 | 0.934441 | 289.0783 | 81.415 | 0.934441 |
| 290.0763 | 84.842 | 0.982368 | 290.0667 | 80.480 | 0.956319 | 290.0667 | 80.480 | 0.956319 |
| 291.0804 | 83.829 | 1.026824 | 291.0689 | 79.511 | 0.974711 | 291.0689 | 79.511 | 0.974711 |
| 292.0800 | 82.784 | 1.069231 | 292.0615 | 78.533 | 0.988736 | 292.0615 | 78.533 | 0.988736 |
| 293.0800 | 81.680 | 1.111873 | 293.0615 | 77.569 | 1.002542 | 293.0615 | 77.569 | 1.002542 |
| 294.0796 | 80.476 | 1.148699 | 294.0592 | 76.508 | 1.014896 | 294.0592 | 76.508 | 1.014896 |
| 295.0820 | 79.343 | 1.181424 | 295.0472 | 75.445 | 1.021812 | 295.0472 | 75.445 | 1.021812 |
| 296.0820 | 78.154 | 1.210279 | 296.0506 | 74.495 | 1.034219 | 296.0506 | 74.495 | 1.034219 |
| 297.0868 | 76.875 | 1.230882 | 297.0744 | 73.406 | 1.058495 | 297.0744 | 73.406 | 1.058495 |
| 298.0853 | 75.634 | 1.244500 | 298.0672 | 72.356 | 1.078199 | 298.0672 | 72.356 | 1.078199 |
| 299.0866 | 74.426 | 1.252552 | 299.0439 | 71.361 | 1.088427 | 299.0439 | 71.361 | 1.088427 |
| 300.0914 | 73.031 | 1.257275 | 300.0646 | 70.277 | 1.098590 | 300.0646 | 70.277 | 1.098590 |
| 301.0776 | 71.856 | 1.272103 | 301.0654 | 68.980 | 1.113605 | 301.0654 | 68.980 | 1.113605 |
| 302.0766 | 70.548 | 1.288627 | 302.0322 | 67.844 | 1.119600 | 302.0322 | 67.844 | 1.119600 |
| 303.0650 | 69.376 | 1.300394 | 303.0453 | 66.771 | 1.121673 | 303.0453 | 66.771 | 1.121673 |
| 304.0618 | 68.133 | 1.302059 | 304.0362 | 65.779 | 1.118448 | 304.0362 | 65.779 | 1.118448 |
| 305.0661 | 66.840 | 1.298411 | 305.0734 | 64.528 | 1.116416 | 305.0734 | 64.528 | 1.116416 |
| 306.0525 | 65.216 | 1.297687 | 306.0608 | 63.417 | 1.135829 | 306.0608 | 63.417 | 1.135829 |
| 307.0429 | 63.964 | 1.312863 | 307.0354 | 62.294 | 1.158751 | 307.0354 | 62.294 | 1.158751 |
| 308.0452 | 62.762 | 1.325724 | 308.0535 | 61.264 | 1.170614 | 308.0535 | 61.264 | 1.170614 |
| 309.0409 | 61.566 | 1.330216 | 309.0572 | 60.191 | 1.171805 | 309.0572 | 60.191 | 1.171805 |
| 310.0496 | 60.337 | 1.326417 | 310.0973 | 58.573 | 1.170904 | 310.0973 | 58.573 | 1.170904 |
| 311.1215 | 58.764 | 1.333251 | 311.0300 | 57.415 | 1.179469 | 311.0300 | 57.415 | 1.179469 |
| 312.0770 | 57.304 | 1.349470 | 312.0105 | 56.333 | 1.179665 | 312.0105 | 56.333 | 1.179665 |
| 313.0852 | 55.997 | 1.359252 | 313.0387 | 55.327 | 1.172730 | 313.0387 | 55.327 | 1.172730 |
| 314.0868 | 54.688 | 1.356022 | 314.0641 | 54.310 | 1.156150 | 314.0641 | 54.310 | 1.156150 |
| 315.0847 | 53.344 | 1.344700 | 315.0781 | 52.836 | 1.141035 | 315.0781 | 52.836 | 1.141035 |
| 316.0640 | 51.998 | 1.333163 | 316.0564 | 51.733 | 1.144759 | 316.0564 | 51.733 | 1.144759 |
| 317.0403 | 50.702 | 1.332364 | 317.0454 | 50.655 | 1.145067 | 317.0454 | 50.655 | 1.145067 |
| 318.0119 | 49.443 | 1.331558 | 318.0381 | 49.488 | 1.135033 | 318.0381 | 49.488 | 1.135033 |
| 318.9802 | 48.239 | 1.328723 | 319.0315 | 48.370 | 1.116477 | 319.0315 | 48.370 | 1.116477 |
| 320.0138 | 46.732 | 1.321444 | 320.0217 | 47.258 | 1.096464 | 320.0217 | 47.258 | 1.096464 |
| 321.0039 | 45.395 | 1.315116 | 321.0070 | 46.190 | 1.084446 | 321.0070 | 46.190 | 1.084446 |
| 322.0098 | 44.120 | 1.307489 | 321.9848 | 45.150 | 1.068749 | 321.9848 | 45.150 | 1.068749 |
| 323.0221 | 42.803 | 1.296869 | 322.9798 | 44.104 | 1.051973 | 322.9798 | 44.104 | 1.051973 |

Table B-1: Continued

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 324.0210 | 41.506 | 1.280258 | 323.9844 | 43.039 | 1.035582 | 323.9844 | 43.039 | 1.035582 |
| 325.0132 | 40.254 | 1.258582 | 324.9826 | 42.016 | 1.020290 | 324.9826 | 42.016 | 1.020290 |
| 326.0069 | 39.002 | 1.243721 | 325.9822 | 40.998 | 1.006979 | 325.9822 | 40.998 | 1.006979 |
| 327.0023 | 37.763 | 1.227081 | 326.9840 | 40.006 | 0.994554 | 326.9840 | 40.006 | 0.994554 |
| 327.9972 | 36.556 | 1.207213 | 327.9926 | 39.018 | 0.982582 | 327.9926 | 39.018 | 0.982582 |
| 328.9966 | 35.354 | 1.186047 | 329.0115 | 38.029 | 0.972816 | 329.0115 | 38.029 | 0.972816 |
| 329.9918 | 34.180 | 1.165621 | 330.0351 | 37.043 | 0.964906 | 330.0351 | 37.043 | 0.964906 |
| 330.9922 | 33.023 | 1.145306 | 331.0442 | 36.074 | 0.956980 | 331.0442 | 36.074 | 0.956980 |
| 331.9933 | 31.895 | 1.125396 | 332.0457 | 35.107 | 0.949512 | 332.0457 | 35.107 | 0.949512 |
| 333.0066 | 30.777 | 1.104469 | 333.0447 | 34.161 | 0.941418 | 333.0447 | 34.161 | 0.941418 |
| 334.0114 | 29.687 | 1.084721 | 334.0340 | 33.225 | 0.932948 | 334.0340 | 33.225 | 0.932948 |
| 335.0208 | 28.580 | 1.065250 | 335.0260 | 32.340 | 0.920941 | 335.0260 | 32.340 | 0.920941 |
| 336.0187 | 27.522 | 1.045011 | 336.0174 | 31.392 | 0.907660 | 336.0174 | 31.392 | 0.907660 |
| 337.0148 | 26.492 | 1.023334 | 337.0084 | 30.496 | 0.893410 | 337.0084 | 30.496 | 0.893410 |
| 338.0047 | 25.482 | 1.002453 | 337.9944 | 29.620 | 0.878689 | 337.9944 | 29.620 | 0.878689 |
| 338.9924 | 24.503 | 0.977015 | 338.9716 | 28.679 | 0.863792 | 338.9716 | 28.679 | 0.863792 |
| 339.9818 | 23.546 | 0.951636 | 339.9845 | 27.919 | 0.848473 | 339.9845 | 27.919 | 0.848473 |
| 340.9802 | 22.621 | 0.927931 | 340.9794 | 27.070 | 0.832131 | 340.9794 | 27.070 | 0.832131 |
| 341.9768 | 21.707 | 0.904069 | 341.9762 | 26.246 | 0.817131 | 341.9762 | 26.246 | 0.817131 |
| 342.9622 | 20.851 | 0.880252 | 342.9748 | 25.437 | 0.802896 | 342.9748 | 25.437 | 0.802896 |
| 343.9672 | 19.953 | 0.857853 | 343.9799 | 24.642 | 0.788699 | 343.9799 | 24.642 | 0.788699 |
| 344.9716 | 19.116 | 0.835708 | 344.9806 | 23.862 | 0.775779 | 344.9806 | 23.862 | 0.775779 |
| 345.9760 | 18.278 | 0.815163 | 345.9722 | 23.094 | 0.761531 | 345.9722 | 23.094 | 0.761531 |
| 346.9826 | 17.489 | 0.794033 | 346.9761 | 22.339 | 0.747749 | 346.9761 | 22.339 | 0.747749 |
| 347.9786 | 16.694 | 0.775777 | 347.9678 | 21.596 | 0.734196 | 347.9678 | 21.596 | 0.734196 |
| 348.9714 | 15.932 | 0.754446 | 348.9625 | 20.873 | 0.720407 | 348.9625 | 20.873 | 0.720407 |
| 349.9638 | 15.190 | 0.734189 | 349.9650 | 20.166 | 0.707173 | 349.9650 | 20.166 | 0.707173 |
| 350.9525 | 14.468 | 0.713174 | 350.9642 | 19.464 | 0.692293 | 350.9642 | 19.464 | 0.692293 |
| 351.9472 | 13.770 | 0.691578 | 351.9619 | 18.781 | 0.677629 | 351.9619 | 18.781 | 0.677629 |
| 352.9390 | 13.093 | 0.670038 | 352.9587 | 18.112 | 0.663202 | 352.9587 | 18.112 | 0.663202 |
| 353.9372 | 12.437 | 0.646832 | 353.9554 | 17.454 | 0.648940 | 353.9554 | 17.454 | 0.648940 |
| 354.9343 | 11.808 | 0.624610 | 354.9350 | 16.751 | 0.635333 | 354.9350 | 16.751 | 0.635333 |
| 355.9340 | 11.201 | 0.603772 | 355.9547 | 16.202 | 0.620350 | 355.9547 | 16.202 | 0.620350 |
| 356.9326 | 10.582 | 0.582808 | 356.9578 | 15.576 | 0.605905 | 356.9578 | 15.576 | 0.605905 |
| 357.9309 | 10.099 | 0.562415 | 357.9498 | 14.975 | 0.591637 | 357.9498 | 14.975 | 0.591637 |
| 358.9338 | 9.482 | 0.542144 | 358.9460 | 14.393 | 0.577025 | 358.9460 | 14.393 | 0.577025 |
| 359.9365 | 8.949 | 0.522216 | 359.9412 | 13.825 | 0.561801 | 359.9412 | 13.825 | 0.561801 |
| 360.9356 | 8.438 | 0.501447 | 360.9358 | 13.273 | 0.548225 | 360.9358 | 13.273 | 0.548225 |
| 361.9352 | 7.945 | 0.482408 | 361.9324 | 12.733 | 0.532845 | 361.9324 | 12.733 | 0.532845 |
| 362.9322 | 7.464 | 0.466151 | 362.9264 | 12.208 | 0.519215 | 362.9264 | 12.208 | 0.519215 |
| 363.9384 | 7.026 | 0.446295 | 363.9240 | 11.701 | 0.504658 | 363.9240 | 11.701 | 0.504658 |
| 364.9404 | 6.580 | 0.429532 | 364.9274 | 11.206 | 0.488220 | 364.9274 | 11.206 | 0.488220 |
| 365.9394 | 6.152 | 0.412176 | 365.9280 | 10.727 | 0.473285 | 365.9280 | 10.727 | 0.473285 |
| 366.9387 | 5.759 | 0.392362 | 366.9253 | 10.259 | 0.457537 | 366.9253 | 10.259 | 0.457537 |
| 367.9416 | 5.377 | 0.374899 | 367.9165 | 9.812 | 0.443650 | 367.9165 | 9.812 | 0.443650 |
| 368.9444 | 5.009 | 0.357553 | 368.9044 | 9.338 | 0.427331 | 368.9044 | 9.338 | 0.427331 |
| 369.9197 | 4.567 | 0.341249 | 369.9210 | 8.979 | 0.411474 | 369.9210 | 8.979 | 0.411474 |
| 370.9340 | 4.352 | 0.324625 | 370.9172 | 8.586 | 0.395403 | 370.9172 | 8.586 | 0.395403 |
| 371.9510 | 4.017 | 0.307060 | 371.9094 | 8.167 | 0.379330 | 371.9094 | 8.167 | 0.379330 |
| 372.9500 | 3.715 | 0.290699 | 372.8784 | 7.716 | 0.364592 | 372.8784 | 7.716 | 0.364592 |
| 373.9488 | 3.426 | 0.274297 | 373.8933 | 7.451 | 0.348385 | 373.8933 | 7.451 | 0.348385 |
| 374.9436 | 3.158 | 0.259176 | 374.8850 | 7.102 | 0.332224 | 374.8850 | 7.102 | 0.332224 |
| 375.9231 | 2.828 | 0.245591 | 375.8788 | 6.781 | 0.316572 | 375.8788 | 6.781 | 0.316572 |
| 376.9381 | 2.685 | 0.226629 | 376.8715 | 6.474 | 0.300362 | 376.8715 | 6.474 | 0.300362 |
| 377.9363 | 2.456 | 0.209975 | 377.8676 | 6.186 | 0.285946 | 377.8676 | 6.186 | 0.285946 |
| 378.9339 | 2.254 | 0.193240 | 378.8695 | 5.911 | 0.269776 | 378.8695 | 5.911 | 0.269776 |
| 379.9335 | 2.071 | 0.176515 | 379.8685 | 5.648 | 0.255794 | 379.8685 | 5.648 | 0.255794 |
| 380.9330 | 1.902 | 0.159910 | 380.8758 | 5.401 | 0.240161 | 380.8758 | 5.401 | 0.240161 |
| 381.9306 | 1.749 | 0.143140 | 381.8781 | 5.166 | 0.225978 | 381.8781 | 5.166 | 0.225978 |
| 382.9292 | 1.615 | 0.125040 | 382.8685 | 4.902 | 0.212378 | 382.8685 | 4.902 | 0.212378 |
| 383.9200 | 1.495 | 0.106646 | 383.8938 | 4.751 | 0.199290 | 383.8938 | 4.751 | 0.199290 |
| 384.9124 | 1.399 | 0.088949 | 384.8852 | 4.504 | 0.186885 | 384.8852 | 4.504 | 0.186885 |
| 385.9003 | 1.318 | 0.071293 | 385.9091 | 4.377 | 0.174864 | 385.9091 | 4.377 | 0.174864 |
| 386.8860 | 1.264 | 0.055742 | 386.8998 | 4.143 | 0.163137 | 386.8998 | 4.143 | 0.163137 |
| 387.8838 | 1.226 | 0.042053 | 387.9202 | 4.048 | 0.152369 | 387.9202 | 4.048 | 0.152369 |
| 388.9000 | 1.201 | 0.031769 | 388.9222 | 3.892 | 0.139923 | 388.9222 | 3.892 | 0.139923 |
| 389.9338 | 1.184 | 0.021258 | 389.9230 | 3.757 | 0.129421 | 389.9230 | 3.757 | 0.129421 |

Table B-1: Continued

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 390.9765 | 1.169 | 0.014972 | 390.9208 | 3.633 | 0.117327 | 390.9208 | 3.633 | 0.117327 |
| 392.0174 | 1.159 | 0.010908 | 391.9212 | 3.522 | 0.106394 | 391.9212 | 3.522 | 0.106394 |
| 393.0589 | 1.151 | 0.008356 | 392.9194 | 3.420 | 0.094864 | 392.9194 | 3.420 | 0.094864 |
| 394.0870 | 1.188 | 0.006867 | 393.9180 | 3.329 | 0.082926 | 393.9180 | 3.329 | 0.082926 |
| 395.1144 | 1.141 | 0.005695 | 394.9134 | 3.255 | 0.072692 | 394.9134 | 3.255 | 0.072692 |
| 396.1254 | 1.134 | 0.004925 | 395.9127 | 3.192 | 0.060651 | 395.9127 | 3.192 | 0.060651 |
| 397.1271 | 1.130 | 0.004388 | 396.9118 | 3.192 | 0.050894 | 396.9118 | 3.192 | 0.050894 |
| 398.1214 | 1.123 | 0.003897 | 397.9231 | 3.100 | 0.041520 | 397.9231 | 3.100 | 0.041520 |
| 399.1168 | 1.120 | 0.005978 | 398.9425 | 3.062 | 0.033959 | 398.9425 | 3.062 | 0.033959 |
| 400.1072 | 1.118 | 0.002579 | 399.9600 | 3.074 | 0.027859 | 399.9600 | 3.074 | 0.027859 |
| 401.1004 | 1.119 | 0.001995 | 400.9914 | 3.013 | 0.022711 | 400.9914 | 3.013 | 0.022711 |
| 402.0956 | 1.113 | 0.001589 | 402.0184 | 2.993 | 0.020409 | 402.0184 | 2.993 | 0.020409 |
| 403.0912 | 1.135 | 0.001341 | 403.0488 | 2.972 | 0.016160 | 403.0488 | 2.972 | 0.016160 |
| 404.0734 | 1.073 | 0.001321 | 404.0642 | 2.958 | 0.013713 | 404.0642 | 2.958 | 0.013713 |
| 405.0908 | 1.119 | 0.001027 | 405.0825 | 2.946 | 0.013149 | 405.0825 | 2.946 | 0.013149 |
| 406.0872 | 1.109 | 0.000998 | 406.0950 | 2.933 | 0.010760 | 406.0950 | 2.933 | 0.010760 |
| 407.0829 | 1.104 | 0.000913 | 407.0987 | 2.924 | 0.009410 | 407.0987 | 2.924 | 0.009410 |
| 408.0826 | 1.104 | 0.001714 | 408.1076 | 2.918 | 0.008051 | 408.1076 | 2.918 | 0.008051 |
| 409.0801 | 1.102 | 0.002766 | 409.1080 | 2.909 | 0.006979 | 409.1080 | 2.909 | 0.006979 |
| 410.0767 | 1.107 | 0.001658 | 410.1075 | 2.903 | 0.006290 | 410.1075 | 2.903 | 0.006290 |
| 411.0750 | 1.101 | 0.001468 | 411.1057 | 2.894 | 0.005748 | 411.1057 | 2.894 | 0.005748 |
| 412.0741 | 1.098 | 0.001474 | 412.1049 | 2.894 | 0.005852 | 412.1049 | 2.894 | 0.005852 |
| 413.0682 | 1.096 | 0.001553 | 413.1036 | 2.890 | 0.005154 | 413.1036 | 2.890 | 0.005154 |
| 414.0646 | 1.093 | 0.003039 | 414.0994 | 2.885 | 0.004566 | 414.0994 | 2.885 | 0.004566 |
| 415.0645 | 1.094 | 0.001445 | 415.0968 | 2.878 | 0.004365 | 415.0968 | 2.878 | 0.004365 |
| 416.0644 | 1.092 | 0.001297 | 416.0875 | 2.873 | 0.004328 | 416.0875 | 2.873 | 0.004328 |
| 417.0582 | 1.091 | 0.001242 | 417.0769 | 2.837 | 0.004255 | 417.0769 | 2.837 | 0.004255 |
| 418.0601 | 1.087 | 0.001356 | 418.0816 | 2.881 | 0.003817 | 418.0816 | 2.881 | 0.003817 |
| 419.0526 | 1.044 | 0.001779 | 419.0794 | 2.863 | 0.003343 | 419.0794 | 2.863 | 0.003343 |
| 420.0696 | 1.092 | 0.001855 | 420.0787 | 2.857 | 0.002964 | 420.0787 | 2.857 | 0.002964 |
| 421.0704 | 1.085 | 0.001691 | 421.0754 | 2.856 | 0.002711 | 421.0754 | 2.856 | 0.002711 |
| 422.0675 | 1.083 | 0.001642 | 422.0726 | 2.851 | 0.002410 | 422.0726 | 2.851 | 0.002410 |
| 423.0635 | 1.081 | 0.003597 | 423.0704 | 2.853 | 0.003204 | 423.0704 | 2.853 | 0.003204 |
| 424.0619 | 1.077 | 0.002298 | 424.0680 | 2.846 | 0.002675 | 424.0680 | 2.846 | 0.002675 |
| 425.0584 | 1.074 | 0.002849 | 425.0680 | 2.846 | 0.003406 | 425.0680 | 2.846 | 0.003406 |
| 426.0582 | 1.079 | 0.000790 | 426.0682 | 2.842 | 0.002473 | 426.0682 | 2.842 | 0.002473 |
| 427.0533 | 1.073 | -0.000127 | 427.0649 | 2.839 | 0.001946 | 427.0649 | 2.839 | 0.001946 |
| 428.0406 | 1.078 | -0.000377 | 428.0634 | 2.832 | 0.001931 | 428.0634 | 2.832 | 0.001931 |
| 429.0542 | 1.084 | -0.000229 | 429.0608 | 2.837 | 0.002304 | 429.0608 | 2.837 | 0.002304 |
| 430.0434 | 1.022 | 0.000789 | 430.0420 | 2.750 | 0.001985 | 430.0420 | 2.750 | 0.001985 |
| 431.0620 | 1.107 | -0.000454 | 431.0609 | 2.849 | 0.001025 | 431.0609 | 2.849 | 0.001025 |
| 432.0597 | 1.075 | -0.000706 | 432.0631 | 2.836 | 0.001212 | 432.0631 | 2.836 | 0.001212 |
| 433.0587 | 1.070 | 0.001855 | 433.0604 | 2.856 | 0.001380 | 433.0604 | 2.856 | 0.001380 |
| 434.0566 | 1.069 | -0.000099 | 434.0467 | 2.765 | 0.001355 | 434.0467 | 2.765 | 0.001355 |
| 435.0519 | 1.151 | 0.001103 | 435.0591 | 2.877 | 0.000993 | 435.0591 | 2.877 | 0.000993 |
| 436.0539 | 1.069 | 0.000871 | 436.0605 | 2.824 | 0.003023 | 436.0605 | 2.824 | 0.003023 |
| 437.0524 | 1.068 | 0.000241 | 437.0523 | 2.806 | 0.000499 | 437.0523 | 2.806 | 0.000499 |
| 438.0523 | 1.070 | 0.000751 | 438.0533 | 2.823 | 0.000842 | 438.0533 | 2.823 | 0.000842 |
| 439.0543 | 1.069 | 0.000485 | 439.0526 | 2.816 | 0.001880 | 439.0526 | 2.816 | 0.001880 |
| 440.0566 | 1.067 | 0.001997 | 440.0542 | 2.830 | 0.001951 | 440.0542 | 2.830 | 0.001951 |
| 441.0575 | 1.065 | 0.000274 | 441.0358 | 2.807 | 0.000697 | 441.0358 | 2.807 | 0.000697 |
| 442.0554 | 1.062 | 0.000520 | 442.0539 | 2.829 | 0.000961 | 442.0539 | 2.829 | 0.000961 |
| 443.0517 | 1.009 | 0.000482 | 443.0592 | 2.815 | 0.002185 | 443.0592 | 2.815 | 0.002185 |
| 444.0543 | 1.084 | 0.000638 | 444.0400 | 2.732 | 0.001539 | 444.0400 | 2.732 | 0.001539 |
| 445.0566 | 1.083 | -0.000245 | 445.0564 | 2.818 | 0.000674 | 445.0564 | 2.818 | 0.000674 |
| 446.0592 | 1.061 | -0.001072 | 446.0545 | 2.806 | 0.002614 | 446.0545 | 2.806 | 0.002614 |
| 447.0554 | 1.062 | -0.001053 | 447.0526 | 2.806 | 0.000816 | 447.0526 | 2.806 | 0.000816 |
| 448.0574 | 1.063 | -0.000739 | 448.0506 | 2.850 | 0.000249 | 448.0506 | 2.850 | 0.000249 |
| 449.0562 | 1.019 | 0.000148 | 449.0444 | 2.810 | 0.002603 | 449.0444 | 2.810 | 0.002603 |
| 450.0591 | 1.106 | 0.000153 | 450.0550 | 2.825 | 0.000314 | 450.0550 | 2.825 | 0.000314 |
| 451.0644 | 1.068 | 0.001342 | 451.0571 | 2.799 | 0.001120 | 451.0571 | 2.799 | 0.001120 |
| 452.0624 | 1.059 | 0.000010 | 452.0544 | 2.810 | 0.000228 | 452.0544 | 2.810 | 0.000228 |
| 453.0584 | 1.061 | 0.000104 | 453.0533 | 2.802 | 0.001629 | 453.0533 | 2.802 | 0.001629 |
| 454.0576 | 1.061 | -0.000026 | 454.0392 | 2.782 | 0.001183 | 454.0392 | 2.782 | 0.001183 |
| 455.0594 | 1.059 | 0.001063 | 455.0588 | 2.814 | 0.000931 | 455.0588 | 2.814 | 0.000931 |
| 456.0463 | 1.079 | -0.000247 | 456.0460 | 2.712 | 0.000887 | 456.0460 | 2.712 | 0.000887 |
| 457.0610 | 1.063 | -0.000607 | 457.0611 | 2.802 | 0.000574 | 457.0611 | 2.802 | 0.000574 |

Table B-1: Continued

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 458.0636 | 1.064 | -0.000609 | 458.0593 | 2.795 | 0.000435 | 458.0593 | 2.795 | 0.000435 |
| 459.0640 | 1.063 | -0.000352 | 459.0596 | 2.791 | 0.002224 | 459.0596 | 2.791 | 0.002224 |
| 460.0659 | 1.067 | -0.000443 | 460.0589 | 2.792 | 0.000863 | 460.0589 | 2.792 | 0.000863 |
| 461.0662 | 1.063 | 0.001722 | 461.0616 | 2.795 | 0.000846 | 461.0616 | 2.795 | 0.000846 |
| 462.0674 | 1.061 | 0.000216 | 462.0602 | 2.792 | 0.001023 | 462.0602 | 2.792 | 0.001023 |
| 463.0662 | 1.060 | 0.000364 | 463.0590 | 2.788 | 0.001079 | 463.0590 | 2.788 | 0.001079 |
| 464.0670 | 1.056 | 0.000354 | 464.0590 | 2.789 | 0.001294 | 464.0590 | 2.789 | 0.001294 |
| 465.0680 | 1.063 | 0.000509 | 465.0633 | 2.790 | 0.001156 | 465.0633 | 2.790 | 0.001156 |
| 466.0656 | 1.060 | 0.000456 | 466.0598 | 2.784 | 0.000675 | 466.0598 | 2.784 | 0.000675 |
| 467.0706 | 1.060 | 0.000441 | 467.0606 | 2.783 | 0.000559 | 467.0606 | 2.783 | 0.000559 |
| 468.0713 | 1.063 | 0.000369 | 468.0586 | 2.785 | 0.001440 | 468.0586 | 2.785 | 0.001440 |
| 469.0740 | 1.056 | 0.002698 | 469.0629 | 2.781 | 0.000616 | 469.0629 | 2.781 | 0.000616 |
| 470.0769 | 1.060 | 0.000105 | 470.0621 | 2.795 | 0.000326 | 470.0621 | 2.795 | 0.000326 |
| 471.0772 | 1.057 | -0.000336 | 471.0640 | 2.790 | 0.000558 | 471.0640 | 2.790 | 0.000558 |
| 472.0744 | 1.061 | -0.000501 | 472.0648 | 2.781 | 0.000447 | 472.0648 | 2.781 | 0.000447 |
| 473.0765 | 1.058 | -0.000318 | 473.0531 | 2.713 | 0.000626 | 473.0531 | 2.713 | 0.000626 |
| 474.0653 | 1.040 | 0.000643 | 474.0679 | 2.795 | 0.001085 | 474.0679 | 2.795 | 0.001085 |
| 475.0852 | 1.072 | -0.000249 | 475.0742 | 2.780 | 0.001073 | 475.0742 | 2.780 | 0.001073 |
| 476.0870 | 1.062 | -0.000673 | 476.0718 | 2.776 | 0.000724 | 476.0718 | 2.776 | 0.000724 |
| 477.0844 | 1.061 | -0.000379 | 477.0716 | 2.779 | 0.002685 | 477.0716 | 2.779 | 0.002685 |
| 478.0844 | 1.056 | -0.000929 | 478.0722 | 2.778 | 0.001488 | 478.0722 | 2.778 | 0.001488 |
| 479.0856 | 1.111 | 0.001555 | 479.0720 | 2.776 | 0.000993 | 479.0720 | 2.776 | 0.000993 |
| 480.0878 | 1.061 | -0.000323 | 480.0685 | 2.781 | -0.000170 | 480.0685 | 2.781 | -0.000170 |
| 481.0894 | 1.062 | -0.000547 | 481.0706 | 2.771 | 0.000545 | 481.0706 | 2.771 | 0.000545 |
| 482.0881 | 1.060 | -0.000953 | 482.0515 | 2.706 | 0.000562 | 482.0515 | 2.706 | 0.000562 |
| 483.0891 | 1.064 | -0.000823 | 483.0642 | 2.741 | 0.000778 | 483.0642 | 2.741 | 0.000778 |
| 484.0896 | 1.065 | 0.000913 | 484.0801 | 2.821 | 0.000855 | 484.0801 | 2.821 | 0.000855 |
| 485.0867 | 1.054 | 0.000222 | 485.0829 | 2.778 | -0.000323 | 485.0829 | 2.778 | -0.000323 |
| 486.0866 | 1.056 | 0.000126 | 486.0707 | 2.725 | -0.000543 | 486.0707 | 2.725 | -0.000543 |
| 487.0875 | 1.066 | 0.002754 | 487.0809 | 2.806 | 0.001144 | 487.0809 | 2.806 | 0.001144 |
| 488.0926 | 1.054 | 0.000756 | 488.0670 | 2.713 | 0.001425 | 488.0670 | 2.713 | 0.001425 |
| 489.1002 | 1.061 | -0.000245 | 489.0785 | 2.837 | 0.003155 | 489.0785 | 2.837 | 0.003155 |
| 490.0998 | 1.057 | 0.000229 | 490.0816 | 2.769 | 0.000292 | 490.0816 | 2.769 | 0.000292 |
| 491.0984 | 1.056 | -0.000017 | 491.0826 | 2.764 | -0.000539 | 491.0826 | 2.764 | -0.000539 |
| 492.0838 | 0.997 | -0.000222 | 492.0792 | 2.762 | 0.000543 | 492.0792 | 2.762 | 0.000543 |
| 493.1010 | 1.116 | -0.000732 | 493.0800 | 2.802 | 0.000226 | 493.0800 | 2.802 | 0.000226 |
| 494.1068 | 1.057 | -0.000792 | 494.0654 | 2.722 | 0.002200 | 494.0654 | 2.722 | 0.002200 |
| 495.1063 | 1.091 | -0.000803 | 495.0877 | 2.798 | 0.000027 | 495.0877 | 2.798 | 0.000027 |
| 496.1056 | 1.066 | -0.000667 | 496.0853 | 2.762 | -0.000049 | 496.0853 | 2.762 | -0.000049 |
| 497.0988 | 1.056 | 0.001192 | 497.0850 | 2.767 | 0.000079 | 497.0850 | 2.767 | 0.000079 |
| 498.0920 | 1.066 | 0.001493 | 498.0852 | 2.748 | 0.001379 | 498.0852 | 2.748 | 0.001379 |
| 499.0892 | 1.053 | -0.000068 | 499.0830 | 2.760 | 0.002108 | 499.0830 | 2.760 | 0.002108 |
| 500.0858 | 1.061 | 0.000963 | 500.0863 | 2.757 | 0.002260 | 500.0863 | 2.757 | 0.002260 |
| 501.0844 | 1.051 | 0.000744 | 501.0877 | 2.753 | 0.000304 | 501.0877 | 2.753 | 0.000304 |
| 502.0824 | 1.058 | 0.000516 | 502.0846 | 2.751 | 0.000177 | 502.0846 | 2.751 | 0.000177 |
| 503.0854 | 1.056 | -0.000036 | 503.0858 | 2.749 | 0.000142 | 503.0858 | 2.749 | 0.000142 |
| 504.0874 | 1.057 | -0.000367 | 504.0859 | 2.758 | 0.000074 | 504.0859 | 2.758 | 0.000074 |
| 505.0906 | 1.054 | -0.000306 | 505.0870 | 2.806 | 0.000758 | 505.0870 | 2.806 | 0.000758 |
| 506.0916 | 1.048 | -0.000470 | 506.0897 | 2.758 | -0.000547 | 506.0897 | 2.758 | -0.000547 |
| 507.0956 | 1.064 | -0.000177 | 507.0928 | 2.753 | -0.000431 | 507.0928 | 2.753 | -0.000431 |
| 508.0961 | 1.060 | 0.000637 | 508.0950 | 2.774 | -0.000049 | 508.0950 | 2.774 | -0.000049 |
| 509.1022 | 1.059 | -0.000175 | 509.0962 | 2.755 | -0.000018 | 509.0962 | 2.755 | -0.000018 |
| 510.1016 | 1.058 | 0.000078 | 510.0924 | 2.741 | 0.001341 | 510.0924 | 2.741 | 0.001341 |
| 511.0996 | 1.059 | 0.000462 | 511.0985 | 2.756 | 0.001752 | 511.0985 | 2.756 | 0.001752 |
| 512.1006 | 1.055 | 0.000302 | 512.0980 | 2.757 | 0.000427 | 512.0980 | 2.757 | 0.000427 |
| 513.0993 | 0.982 | 0.000099 | 513.0947 | 2.750 | 0.000982 | 513.0947 | 2.750 | 0.000982 |
| 514.1060 | 1.063 | 0.000119 | 514.0984 | 2.750 | 0.000896 | 514.0984 | 2.750 | 0.000896 |
| 515.1078 | 1.054 | 0.000294 | 515.0965 | 2.748 | 0.001576 | 515.0965 | 2.748 | 0.001576 |
| 516.1040 | 1.059 | 0.000052 | 516.0900 | 2.761 | 0.000340 | 516.0900 | 2.761 | 0.000340 |
| 517.1021 | 1.060 | 0.000241 | 517.0965 | 2.751 | 0.000670 | 517.0965 | 2.751 | 0.000670 |
| 518.1000 | 1.055 | 0.000298 | 518.1007 | 2.751 | 0.000153 | 518.1007 | 2.751 | 0.000153 |
| 519.0971 | 1.055 | 0.000357 | 519.0976 | 2.747 | 0.000025 | 519.0976 | 2.747 | 0.000025 |
| 520.0992 | 1.049 | 0.000424 | 520.1002 | 2.755 | -0.000252 | 520.1002 | 2.755 | -0.000252 |
| 521.1049 | 1.050 | 0.000354 | 521.1033 | 2.748 | 0.001784 | 521.1033 | 2.748 | 0.001784 |
| 522.1096 | 1.050 | -0.000099 | 522.0996 | 2.755 | 0.000666 | 522.0996 | 2.755 | 0.000666 |
| 523.1110 | 1.054 | -0.000101 | 523.1044 | 2.754 | 0.000562 | 523.1044 | 2.754 | 0.000562 |
| 524.1160 | 1.055 | 0.000000 | 524.1049 | 2.743 | 0.000934 | 524.1049 | 2.743 | 0.000934 |

Table B-1: Continued

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 525.1157 | 1.056 | 0.000009 | 525.1054 | 2.747 | 0.000691 | 525.1054 | 2.747 | 0.000691 |
| 526.1200 | 1.057 | 0.000442 | 526.1036 | 2.741 | 0.000510 | 526.1036 | 2.741 | 0.000510 |
| 527.1204 | 1.051 | 0.000438 | 527.1033 | 2.748 | 0.000652 | 527.1033 | 2.748 | 0.000652 |
| 528.1232 | 1.048 | 0.000081 | 528.1038 | 2.742 | 0.000274 | 528.1038 | 2.742 | 0.000274 |
| 529.1240 | 1.051 | -0.001044 | 529.1054 | 2.746 | 0.000210 | 529.1054 | 2.746 | 0.000210 |
| 530.1213 | 1.058 | -0.000694 | 530.1050 | 2.740 | 0.000387 | 530.1050 | 2.740 | 0.000387 |
| 531.1164 | 1.053 | -0.000808 | 531.1074 | 2.743 | 0.000386 | 531.1074 | 2.743 | 0.000386 |
| 532.1191 | 1.022 | -0.000843 | 532.1084 | 2.744 | 0.000502 | 532.1084 | 2.744 | 0.000502 |
| 533.1272 | 1.111 | -0.000748 | 533.1097 | 2.742 | 0.000506 | 533.1097 | 2.742 | 0.000506 |
| 534.1262 | 1.049 | -0.000744 | 534.1108 | 2.742 | 0.000652 | 534.1108 | 2.742 | 0.000652 |
| 535.1222 | 1.057 | -0.000617 | 535.1101 | 2.736 | 0.000763 | 535.1101 | 2.736 | 0.000763 |
| 536.1222 | 1.057 | 0.000204 | 536.1113 | 2.752 | 0.002553 | 536.1113 | 2.752 | 0.002553 |
| 537.1182 | 1.054 | 0.000105 | 537.1114 | 2.734 | 0.002745 | 537.1114 | 2.734 | 0.002745 |
| 538.1200 | 1.058 | 0.000804 | 538.1152 | 2.742 | 0.000112 | 538.1152 | 2.742 | 0.000112 |
| 539.1206 | 1.057 | -0.000772 | 539.1161 | 2.741 | 0.001549 | 539.1161 | 2.741 | 0.001549 |
| 540.1216 | 1.055 | -0.000370 | 540.1160 | 2.736 | 0.000191 | 540.1160 | 2.736 | 0.000191 |
| 541.1192 | 1.054 | -0.000560 | 541.1015 | 2.673 | -0.000060 | 541.1015 | 2.673 | -0.000060 |
| 542.1248 | 1.078 | -0.000361 | 542.1085 | 2.735 | -0.000445 | 542.1085 | 2.735 | -0.000445 |
| 543.1265 | 1.059 | -0.000159 | 543.1231 | 2.744 | -0.000367 | 543.1231 | 2.744 | -0.000367 |
| 544.1258 | 1.058 | -0.000296 | 544.1094 | 2.649 | 0.000630 | 544.1094 | 2.649 | 0.000630 |
| 545.1269 | 1.060 | 0.000289 | 545.1240 | 2.743 | -0.001323 | 545.1240 | 2.743 | -0.001323 |
| 546.1252 | 1.061 | -0.000150 | 546.1239 | 2.738 | -0.000207 | 546.1239 | 2.738 | -0.000207 |
| 547.1238 | 1.053 | 0.000213 | 547.1209 | 2.733 | 0.001770 | 547.1209 | 2.733 | 0.001770 |
| 548.1245 | 1.054 | -0.000091 | 548.1196 | 2.738 | -0.000315 | 548.1196 | 2.738 | -0.000315 |
| 549.1244 | 1.058 | 0.000165 | 549.1062 | 2.663 | 0.000192 | 549.1062 | 2.663 | 0.000192 |
| 550.1218 | 1.054 | -0.000283 | 550.1256 | 2.741 | 0.000301 | 550.1256 | 2.741 | 0.000301 |
| 551.1282 | 1.068 | -0.000433 | 551.1254 | 2.731 | 0.000126 | 551.1254 | 2.731 | 0.000126 |
| 552.1291 | 1.056 | -0.000348 | 552.1262 | 2.735 | 0.000240 | 552.1262 | 2.735 | 0.000240 |
| 553.1307 | 1.052 | -0.000091 | 553.1270 | 2.732 | 0.001635 | 553.1270 | 2.732 | 0.001635 |
| 554.1277 | 1.048 | -0.000026 | 554.1258 | 2.733 | 0.001400 | 554.1258 | 2.733 | 0.001400 |
| 555.1320 | 1.061 | 0.000543 | 555.1262 | 2.732 | 0.000333 | 555.1262 | 2.732 | 0.000333 |
| 556.1370 | 1.059 | 0.000237 | 556.1262 | 2.733 | 0.000248 | 556.1262 | 2.733 | 0.000248 |
| 557.1366 | 1.056 | -0.000041 | 557.1253 | 2.728 | 0.000199 | 557.1253 | 2.728 | 0.000199 |
| 558.1360 | 1.057 | -0.000213 | 558.1280 | 2.766 | 0.000097 | 558.1280 | 2.766 | 0.000097 |
| 559.1364 | 1.058 | -0.000010 | 559.1276 | 2.724 | -0.000163 | 559.1276 | 2.724 | -0.000163 |
| 560.1392 | 1.057 | -0.000201 | 560.1318 | 2.736 | 0.000642 | 560.1318 | 2.736 | 0.000642 |
| 561.1400 | 1.059 | -0.000162 | 561.1294 | 2.730 | -0.000110 | 561.1294 | 2.730 | -0.000110 |
| 562.1368 | 1.058 | -0.000163 | 562.1308 | 2.731 | 0.001165 | 562.1308 | 2.731 | 0.001165 |
| 563.1376 | 1.060 | 0.000029 | 563.1319 | 2.730 | 0.001038 | 563.1319 | 2.730 | 0.001038 |
| 564.1386 | 1.062 | 0.001469 | 564.1330 | 2.733 | -0.000239 | 564.1330 | 2.733 | -0.000239 |
| 565.1394 | 1.052 | 0.000377 | 565.1226 | 2.663 | -0.000176 | 565.1226 | 2.663 | -0.000176 |
| 566.1387 | 1.054 | 0.000457 | 566.1372 | 2.747 | -0.000195 | 566.1372 | 2.747 | -0.000195 |
| 567.1418 | 1.057 | 0.000417 | 567.1347 | 2.753 | -0.000103 | 567.1347 | 2.753 | -0.000103 |
| 568.1440 | 1.060 | -0.000014 | 568.1419 | 2.737 | -0.000023 | 568.1419 | 2.737 | -0.000023 |
| 569.1380 | 0.958 | 0.001383 | 569.1412 | 2.732 | -0.000287 | 569.1412 | 2.732 | -0.000287 |
| 570.1492 | 1.062 | -0.000634 | 570.1406 | 2.723 | -0.000299 | 570.1406 | 2.723 | -0.000299 |
| 571.1549 | 1.058 | -0.000830 | 571.1401 | 2.732 | 0.000244 | 571.1401 | 2.732 | 0.000244 |
| 572.1571 | 1.056 | -0.000949 | 572.1392 | 2.730 | 0.001804 | 572.1392 | 2.730 | 0.001804 |
| 573.1584 | 1.061 | -0.000969 | 573.1440 | 2.726 | 0.000483 | 573.1440 | 2.726 | 0.000483 |
| 574.1490 | 1.112 | -0.000699 | 574.1461 | 2.730 | 0.000041 | 574.1461 | 2.730 | 0.000041 |
| 575.1592 | 1.065 | -0.000687 | 575.1450 | 2.727 | 0.000079 | 575.1450 | 2.727 | 0.000079 |
| 576.1568 | 1.060 | 0.001513 | 576.1443 | 2.725 | 0.000185 | 576.1443 | 2.725 | 0.000185 |
| 577.1591 | 1.059 | -0.000571 | 577.1425 | 2.721 | 0.000237 | 577.1425 | 2.721 | 0.000237 |
| 578.1567 | 1.058 | -0.000682 | 578.1460 | 2.728 | 0.001444 | 578.1460 | 2.728 | 0.001444 |
| 579.1562 | 1.062 | 0.001599 | 579.1484 | 2.728 | 0.000533 | 579.1484 | 2.728 | 0.000533 |
| 580.1568 | 1.064 | -0.000096 | 580.1496 | 2.722 | 0.000214 | 580.1496 | 2.722 | 0.000214 |
| 581.1450 | 0.981 | -0.000278 | 581.1497 | 2.731 | 0.000155 | 581.1497 | 2.731 | 0.000155 |
| 582.1604 | 1.073 | -0.000145 | 582.1496 | 2.720 | 0.001282 | 582.1496 | 2.720 | 0.001282 |
| 583.1610 | 1.059 | -0.000080 | 583.1372 | 2.640 | -0.000046 | 583.1372 | 2.640 | -0.000046 |
| 584.1610 | 1.058 | -0.000123 | 584.1509 | 2.729 | 0.000268 | 584.1509 | 2.729 | 0.000268 |
| 585.1596 | 1.061 | -0.000184 | 585.1536 | 2.728 | 0.000141 | 585.1536 | 2.728 | 0.000141 |
| 586.1596 | 1.060 | 0.001401 | 586.1516 | 2.729 | 0.000037 | 586.1516 | 2.729 | 0.000037 |
| 587.1606 | 1.058 | 0.000454 | 587.1428 | 2.706 | -0.000314 | 587.1428 | 2.706 | -0.000314 |
| 588.1622 | 1.059 | 0.000387 | 588.1464 | 2.730 | 0.000356 | 588.1464 | 2.730 | 0.000356 |
| 589.1656 | 1.059 | 0.000447 | 589.1441 | 2.710 | 0.000770 | 589.1441 | 2.710 | 0.000770 |
| 590.1651 | 1.061 | 0.000140 | 590.1502 | 2.733 | -0.000380 | 590.1502 | 2.733 | -0.000380 |
| 591.1685 | 1.056 | -0.000307 | 591.1568 | 2.726 | -0.000459 | 591.1568 | 2.726 | -0.000459 |

Table B-1: Continued

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 592.1687 | 1.058 | -0.000386 | 592.1590 | 2.725 | 0.000477 | 592.1590 | 2.725 | 0.000477 |
| 593.1688 | 1.056 | -0.000556 | 593.1474 | 2.664 | -0.000565 | 593.1474 | 2.664 | -0.000565 |
| 594.1713 | 1.059 | -0.000879 | 594.1590 | 2.774 | -0.000230 | 594.1590 | 2.774 | -0.000230 |
| 595.1722 | 1.064 | -0.000930 | 595.1594 | 2.729 | 0.000257 | 595.1594 | 2.729 | 0.000257 |
| 596.1744 | 1.062 | -0.000825 | 596.1592 | 2.722 | 0.001414 | 596.1592 | 2.722 | 0.001414 |
| 597.1738 | 1.061 | -0.000718 | 597.1606 | 2.725 | -0.000103 | 597.1606 | 2.725 | -0.000103 |
| 598.1709 | 1.064 | -0.000327 | 598.1592 | 2.726 | -0.000331 | 598.1592 | 2.726 | -0.000331 |
| 599.1734 | 1.063 | 0.000071 | 599.1609 | 2.722 | 0.000997 | 599.1609 | 2.722 | 0.000997 |
| 600.1720 | 1.060 | 0.000127 | 600.1612 | 2.719 | -0.000433 | 600.1612 | 2.719 | -0.000433 |
| 601.1760 | 1.068 | 0.000008 | 601.1562 | 2.739 | -0.000620 | 601.1562 | 2.739 | -0.000620 |
| 602.1736 | 1.062 | 0.000212 | 602.1654 | 2.730 | -0.000607 | 602.1654 | 2.730 | -0.000607 |
| 603.1741 | 1.061 | 0.000709 | 603.1711 | 2.726 | -0.000141 | 603.1711 | 2.726 | -0.000141 |
| 604.1760 | 1.062 | 0.000100 | 604.1709 | 2.723 | -0.000014 | 604.1709 | 2.723 | -0.000014 |
| 605.1783 | 1.063 | 0.000017 | 605.1749 | 2.731 | -0.000081 | 605.1749 | 2.731 | -0.000081 |
| 606.1800 | 1.060 | -0.000338 | 606.1743 | 2.724 | 0.001394 | 606.1743 | 2.724 | 0.001394 |
| 607.1793 | 1.064 | 0.000342 | 607.1710 | 2.726 | -0.000258 | 607.1710 | 2.726 | -0.000258 |
| 608.1780 | 1.008 | -0.000739 | 608.1690 | 2.714 | -0.000562 | 608.1690 | 2.714 | -0.000562 |
| 609.1821 | 1.080 | -0.000875 | 609.1697 | 2.720 | -0.000519 | 609.1697 | 2.720 | -0.000519 |
| 610.1861 | 1.085 | -0.000531 | 610.1750 | 2.728 | -0.000495 | 610.1750 | 2.728 | -0.000495 |
| 611.1895 | 1.066 | -0.000521 | 611.1758 | 2.730 | -0.000586 | 611.1758 | 2.730 | -0.000586 |
| 612.1824 | 0.964 | -0.000542 | 612.1758 | 2.729 | -0.000559 | 612.1758 | 2.729 | -0.000559 |
| 613.1918 | 1.085 | 0.001227 | 613.1765 | 2.726 | -0.000277 | 613.1765 | 2.726 | -0.000277 |
| 614.1926 | 1.059 | -0.000449 | 614.1748 | 2.729 | -0.000106 | 614.1748 | 2.729 | -0.000106 |
| 615.1944 | 1.061 | -0.000553 | 615.1750 | 2.715 | -0.000005 | 615.1750 | 2.715 | -0.000005 |
| 616.1968 | 1.063 | -0.001103 | 616.1715 | 2.725 | -0.000049 | 616.1715 | 2.725 | -0.000049 |
| 617.1968 | 1.054 | -0.000815 | 617.1738 | 2.733 | 0.000115 | 617.1738 | 2.733 | 0.000115 |
| 618.1851 | 1.012 | -0.000657 | 618.1787 | 2.727 | -0.000124 | 618.1787 | 2.727 | -0.000124 |
| 619.2018 | 1.087 | -0.001007 | 619.1778 | 2.735 | -0.000109 | 619.1778 | 2.735 | -0.000109 |
| 620.2045 | 1.063 | -0.000950 | 620.1780 | 2.721 | 0.000010 | 620.1780 | 2.721 | 0.000010 |
| 621.1974 | 1.065 | -0.001398 | 621.1826 | 2.729 | 0.000449 | 621.1826 | 2.729 | 0.000449 |
| 622.1914 | 1.065 | -0.001349 | 622.1828 | 2.723 | 0.000451 | 622.1828 | 2.723 | 0.000451 |
| 623.1907 | 1.062 | 0.001153 | 623.1826 | 2.724 | 0.000224 | 623.1826 | 2.724 | 0.000224 |
| 624.1942 | 1.063 | 0.002092 | 624.1802 | 2.728 | -0.000007 | 624.1802 | 2.728 | -0.000007 |
| 625.1930 | 1.072 | -0.000665 | 625.1807 | 2.722 | -0.000139 | 625.1807 | 2.722 | -0.000139 |
| 626.1981 | 1.071 | -0.000789 | 626.1794 | 2.722 | -0.000215 | 626.1794 | 2.722 | -0.000215 |
| 627.1965 | 1.062 | -0.000891 | 627.1822 | 2.732 | 0.000020 | 627.1822 | 2.732 | 0.000020 |
| 628.1989 | 1.048 | -0.000681 | 628.1866 | 2.730 | 0.000222 | 628.1866 | 2.730 | 0.000222 |
| 629.1938 | 1.136 | -0.000543 | 629.1887 | 2.719 | 0.000446 | 629.1887 | 2.719 | 0.000446 |
| 630.2039 | 1.073 | -0.000463 | 630.1884 | 2.719 | -0.000003 | 630.1884 | 2.719 | -0.000003 |
| 631.2036 | 1.069 | -0.001117 | 631.1915 | 2.717 | -0.000578 | 631.1915 | 2.717 | -0.000578 |
| 632.2071 | 1.066 | -0.001240 | 632.1894 | 2.729 | -0.000518 | 632.1894 | 2.729 | -0.000518 |
| 633.2046 | 1.065 | -0.001127 | 633.1894 | 2.722 | -0.000165 | 633.1894 | 2.722 | -0.000165 |
| 634.2050 | 1.072 | 0.001601 | 634.1879 | 2.722 | -0.000392 | 634.1879 | 2.722 | -0.000392 |
| 635.2039 | 1.061 | -0.000204 | 635.1948 | 2.743 | -0.000893 | 635.1948 | 2.743 | -0.000893 |
| 636.2070 | 1.077 | -0.000128 | 636.1974 | 2.723 | -0.001149 | 636.1974 | 2.723 | -0.001149 |
| 637.2114 | 1.064 | -0.000229 | 637.1985 | 2.739 | -0.000722 | 637.1985 | 2.739 | -0.000722 |
| 638.2144 | 1.071 | -0.000081 | 638.1992 | 2.716 | -0.000380 | 638.1992 | 2.716 | -0.000380 |
| 639.2153 | 1.105 | 0.003026 | 639.1950 | 2.734 | 0.000103 | 639.1950 | 2.734 | 0.000103 |
| 640.2165 | 1.058 | 0.001625 | 640.1972 | 2.730 | 0.000027 | 640.1972 | 2.730 | 0.000027 |
| 641.2180 | 1.069 | 0.000193 | 641.1988 | 2.731 | -0.000906 | 641.1988 | 2.731 | -0.000906 |
| 642.2190 | 1.069 | -0.000432 | 642.1967 | 2.727 | -0.000370 | 642.1967 | 2.727 | -0.000370 |
| 643.2214 | 1.072 | -0.001483 | 643.1957 | 2.725 | 0.000082 | 643.1957 | 2.725 | 0.000082 |
| 644.2094 | 1.041 | -0.001647 | 644.1970 | 2.733 | 0.000390 | 644.1970 | 2.733 | 0.000390 |
| 645.2234 | 1.144 | -0.002265 | 645.2022 | 2.725 | -0.000120 | 645.2022 | 2.725 | -0.000120 |
| 646.2346 | 1.146 | -0.001488 | 646.2044 | 2.734 | 0.001869 | 646.2044 | 2.734 | 0.001869 |
| 647.2332 | 1.136 | -0.001521 | 647.2026 | 2.729 | -0.000357 | 647.2026 | 2.729 | -0.000357 |
| 648.2278 | 1.076 | -0.001618 | 648.2032 | 2.731 | -0.000686 | 648.2032 | 2.731 | -0.000686 |
| 649.2200 | 1.072 | 0.001969 | 649.1992 | 2.732 | -0.000406 | 649.1992 | 2.732 | -0.000406 |
| 650.2153 | 1.080 | 0.002267 | 650.2024 | 2.727 | -0.000765 | 650.2024 | 2.727 | -0.000765 |
| 651.2134 | 1.064 | 0.001985 | 651.1952 | 2.723 | -0.001305 | 651.1952 | 2.723 | -0.001305 |
| 652.2117 | 1.071 | 0.001873 | 652.2134 | 2.744 | -0.001473 | 652.2134 | 2.744 | -0.001473 |
| 653.2137 | 1.075 | 0.000248 | 653.2150 | 2.740 | -0.000865 | 653.2150 | 2.740 | -0.000865 |
| 654.2150 | 1.072 | -0.000070 | 654.2114 | 2.731 | -0.001241 | 654.2114 | 2.731 | -0.001241 |
| 655.2170 | 1.056 | -0.000366 | 655.2102 | 2.737 | -0.001244 | 655.2102 | 2.737 | -0.001244 |
| 656.2168 | 1.065 | -0.000115 | 656.2138 | 2.740 | 0.003813 | 656.2138 | 2.740 | 0.003813 |
| 657.2172 | 1.073 | 0.000085 | 657.2132 | 2.731 | 0.000074 | 657.2132 | 2.731 | 0.000074 |
| 658.2224 | 1.070 | -0.000037 | 658.2131 | 2.722 | -0.000483 | 658.2131 | 2.722 | -0.000483 |

Table B-1: Continued

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 659.2178 | 1.067 | -0.000074 | 659.2174 | 2.746 | 0.000862 | 659.2174 | 2.746 | 0.000862 |
| 660.2206 | 1.068 | -0.000518 | 660.2161 | 2.728 | 0.000372 | 660.2161 | 2.728 | 0.000372 |
| 661.2218 | 1.072 | -0.000051 | 661.2058 | 2.697 | -0.000699 | 661.2058 | 2.697 | -0.000699 |
| 662.2236 | 1.069 | 0.000081 | 662.2214 | 2.749 | -0.001182 | 662.2214 | 2.749 | -0.001182 |
| 663.2260 | 1.076 | -0.000119 | 663.2199 | 2.730 | -0.000928 | 663.2199 | 2.730 | -0.000928 |
| 664.2270 | 1.070 | -0.000063 | 664.2110 | 2.680 | 0.000888 | 664.2110 | 2.680 | 0.000888 |
| 665.2272 | 1.070 | -0.000005 | 665.2200 | 2.767 | -0.001206 | 665.2200 | 2.767 | -0.001206 |
| 666.2262 | 1.068 | 0.000027 | 666.2241 | 2.741 | 0.001156 | 666.2241 | 2.741 | 0.001156 |
| 667.2245 | 1.068 | 0.000026 | 667.2231 | 2.740 | -0.000179 | 667.2231 | 2.740 | -0.000179 |
| 668.2294 | 1.071 | -0.000167 | 668.2219 | 2.740 | -0.000676 | 668.2219 | 2.740 | -0.000676 |
| 669.2321 | 1.069 | -0.000885 | 669.2102 | 2.643 | -0.000040 | 669.2102 | 2.643 | -0.000040 |
| 670.2310 | 1.072 | -0.000292 | 670.2265 | 2.744 | 0.003258 | 670.2265 | 2.744 | 0.003258 |
| 671.2302 | 1.076 | -0.000853 | 671.2247 | 2.727 | -0.000300 | 671.2247 | 2.727 | -0.000300 |
| 672.2344 | 1.082 | -0.000859 | 672.2294 | 2.741 | -0.000958 | 672.2294 | 2.741 | -0.000958 |
| 673.2334 | 1.112 | -0.000972 | 673.2275 | 2.728 | -0.001304 | 673.2275 | 2.728 | -0.001304 |
| 674.2332 | 1.073 | -0.000696 | 674.2250 | 2.715 | 0.002110 | 674.2250 | 2.715 | 0.002110 |
| 675.2554 | 1.102 | -0.000431 | 675.2221 | 2.717 | 0.000332 | 675.2221 | 2.717 | 0.000332 |
| 676.2562 | 1.076 | -0.000344 | 676.2346 | 2.746 | -0.000905 | 676.2346 | 2.746 | -0.000905 |
| 677.2554 | 1.076 | 0.000036 | 677.2324 | 2.741 | -0.000844 | 677.2324 | 2.741 | -0.000844 |
| 678.2503 | 1.072 | -0.000079 | 678.2343 | 2.733 | -0.001245 | 678.2343 | 2.733 | -0.001245 |
| 679.2462 | 1.070 | -0.000156 | 679.2176 | 2.653 | -0.000509 | 679.2176 | 2.653 | -0.000509 |
| 680.2403 | 1.073 | 0.002202 | 680.2334 | 2.798 | 0.001493 | 680.2334 | 2.798 | 0.001493 |
| 681.2447 | 1.079 | 0.000873 | 681.2395 | 2.737 | -0.000554 | 681.2395 | 2.737 | -0.000554 |
| 682.2500 | 1.074 | 0.000444 | 682.2349 | 2.735 | -0.001355 | 682.2349 | 2.735 | -0.001355 |
| 683.2538 | 1.074 | 0.001320 | 683.2336 | 2.740 | -0.001712 | 683.2336 | 2.740 | -0.001712 |
| 684.2512 | 1.069 | -0.000566 | 684.2306 | 2.785 | 0.000054 | 684.2306 | 2.785 | 0.000054 |
| 685.2445 | 0.960 | -0.000990 | 685.2332 | 2.738 | 0.001935 | 685.2332 | 2.738 | 0.001935 |
| 686.2529 | 1.123 | -0.000795 | 686.2326 | 2.738 | -0.000189 | 686.2326 | 2.738 | -0.000189 |
| 687.2522 | 1.063 | -0.000575 | 687.2343 | 2.741 | -0.000341 | 687.2343 | 2.741 | -0.000341 |
| 688.2460 | 1.125 | -0.001482 | 688.2347 | 2.738 | -0.000553 | 688.2347 | 2.738 | -0.000553 |
| 689.2506 | 1.093 | -0.001160 | 689.2341 | 2.745 | 0.000617 | 689.2341 | 2.745 | 0.000617 |
| 690.2520 | 1.072 | -0.000462 | 690.2309 | 2.781 | -0.000353 | 690.2309 | 2.781 | -0.000353 |
| 691.2478 | 1.066 | 0.000574 | 691.2379 | 2.737 | -0.000487 | 691.2379 | 2.737 | -0.000487 |
| 692.2444 | 1.072 | -0.000159 | 692.2426 | 2.734 | -0.000798 | 692.2426 | 2.734 | -0.000798 |
| 693.2450 | 1.077 | 0.002294 | 693.2422 | 2.745 | -0.001005 | 693.2422 | 2.745 | -0.001005 |
| 694.2486 | 1.071 | 0.000481 | 694.2449 | 2.737 | -0.000700 | 694.2449 | 2.737 | -0.000700 |
| 695.2545 | 1.069 | 0.000477 | 695.2451 | 2.742 | 0.000985 | 695.2451 | 2.742 | 0.000985 |
| 696.2564 | 1.073 | -0.000947 | 696.2474 | 2.750 | -0.000046 | 696.2474 | 2.750 | -0.000046 |
| 697.2558 | 1.073 | -0.000335 | 697.2432 | 2.732 | -0.000131 | 697.2432 | 2.732 | -0.000131 |
| 698.2574 | 1.071 | 0.000423 | 698.2412 | 2.748 | -0.000025 | 698.2412 | 2.748 | -0.000025 |
| 699.2608 | 1.075 | -0.000143 | 699.2384 | 2.733 | -0.000297 | 699.2384 | 2.733 | -0.000297 |
| 700.2609 | 1.133 | -0.000131 | 700.2446 | 2.732 | 0.000335 | 700.2446 | 2.732 | 0.000335 |
| 701.2644 | 1.085 | 0.000024 | 701.2468 | 2.739 | 0.002769 | 701.2468 | 2.739 | 0.002769 |
| 702.2578 | 1.070 | 0.000096 | 702.2420 | 2.741 | -0.000442 | 702.2420 | 2.741 | -0.000442 |
| 703.2566 | 1.052 | -0.000122 | 703.2472 | 2.745 | -0.000695 | 703.2472 | 2.745 | -0.000695 |
| 704.2590 | 1.084 | -0.000265 | 704.2497 | 2.746 | -0.000595 | 704.2497 | 2.746 | -0.000595 |
| 705.2556 | 1.069 | 0.001375 | 705.2450 | 2.723 | -0.000141 | 705.2450 | 2.723 | -0.000141 |
| 706.2568 | 1.068 | -0.000737 | 706.2410 | 2.785 | -0.000338 | 706.2410 | 2.785 | -0.000338 |
| 707.2541 | 1.066 | -0.000658 | 707.2578 | 2.762 | -0.000601 | 707.2578 | 2.762 | -0.000601 |
| 708.2571 | 1.074 | -0.000228 | 708.2598 | 2.739 | -0.000551 | 708.2598 | 2.739 | -0.000551 |
| 709.2594 | 1.072 | -0.000261 | 709.2563 | 2.733 | -0.001005 | 709.2563 | 2.733 | -0.001005 |
| 710.2648 | 1.075 | -0.000471 | 710.2560 | 2.740 | -0.001004 | 710.2560 | 2.740 | -0.001004 |
| 711.2655 | 1.073 | -0.000203 | 711.2538 | 2.740 | 0.002994 | 711.2538 | 2.740 | 0.002994 |
| 712.2688 | 1.069 | 0.000362 | 712.2589 | 2.738 | 0.000171 | 712.2589 | 2.738 | 0.000171 |
| 713.2690 | 1.075 | 0.000064 | 713.2593 | 2.735 | -0.000380 | 713.2593 | 2.735 | -0.000380 |
| 714.2676 | 1.075 | -0.000103 | 714.2582 | 2.743 | -0.000508 | 714.2582 | 2.743 | -0.000508 |
| 715.2739 | 1.071 | -0.000241 | 715.2570 | 2.744 | -0.000295 | 715.2570 | 2.744 | -0.000295 |
| 716.2720 | 1.072 | 0.001193 | 716.2624 | 2.737 | -0.000403 | 716.2624 | 2.737 | -0.000403 |
| 717.2666 | 1.113 | -0.000067 | 717.2618 | 2.744 | -0.000542 | 717.2618 | 2.744 | -0.000542 |
| 718.2759 | 1.078 | -0.000104 | 718.2640 | 2.744 | 0.000876 | 718.2640 | 2.744 | 0.000876 |
| 719.2750 | 1.072 | 0.000232 | 719.2651 | 2.747 | -0.000136 | 719.2651 | 2.747 | -0.000136 |
| 720.2730 | 1.071 | -0.000409 | 720.2647 | 2.744 | -0.000392 | 720.2647 | 2.744 | -0.000392 |
| 721.2661 | 0.968 | 0.001228 | 721.2616 | 2.745 | -0.000314 | 721.2616 | 2.745 | -0.000314 |
| 722.2788 | 1.081 | 0.001758 | 722.2622 | 2.744 | 0.002205 | 722.2622 | 2.744 | 0.002205 |
| 723.2778 | 1.050 | 0.000263 | 723.2612 | 2.799 | 0.001573 | 723.2612 | 2.799 | 0.001573 |
| 724.2750 | 1.118 | -0.001018 | 724.2676 | 2.744 | -0.000471 | 724.2676 | 2.744 | -0.000471 |
| 725.2775 | 1.066 | -0.001263 | 725.2682 | 2.746 | -0.000412 | 725.2682 | 2.746 | -0.000412 |

Table B-1: Continued

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 726.2766 | 1.115 | -0.000735 | 726.2669 | 2.740 | -0.001185 | 726.2669 | 2.740 | -0.001185 |
| 727.2771 | 0.987 | -0.000605 | 727.2579 | 2.680 | -0.001792 | 727.2579 | 2.680 | -0.001792 |
| 728.2850 | 1.123 | -0.000889 | 728.2706 | 2.816 | 0.000041 | 728.2706 | 2.816 | 0.000041 |
| 729.2844 | 1.073 | 0.000547 | 729.2759 | 2.747 | -0.001384 | 729.2759 | 2.747 | -0.001384 |
| 730.2842 | 1.067 | 0.001714 | 730.2740 | 2.740 | -0.000986 | 730.2740 | 2.740 | -0.000986 |
| 731.2756 | 1.067 | 0.001442 | 731.2739 | 2.757 | -0.000734 | 731.2739 | 2.757 | -0.000734 |
| 732.2810 | 1.067 | -0.000745 | 732.2722 | 2.746 | 0.001173 | 732.2722 | 2.746 | 0.001173 |
| 733.2834 | 1.065 | 0.001446 | 733.2700 | 2.743 | 0.002633 | 733.2700 | 2.743 | 0.002633 |
| 734.2843 | 1.069 | -0.000787 | 734.2719 | 2.743 | 0.000709 | 734.2719 | 2.743 | 0.000709 |
| 735.2796 | 0.988 | -0.001498 | 735.2751 | 2.733 | 0.001450 | 735.2751 | 2.733 | 0.001450 |
| 736.3007 | 1.108 | -0.001198 | 736.2821 | 2.743 | 0.000534 | 736.2821 | 2.743 | 0.000534 |
| 737.3070 | 1.074 | -0.001007 | 737.2832 | 2.744 | -0.000127 | 737.2832 | 2.744 | -0.000127 |
| 738.3008 | 0.941 | -0.000301 | 738.2839 | 2.744 | -0.000614 | 738.2839 | 2.744 | -0.000614 |
| 739.3081 | 1.109 | -0.001031 | 739.2765 | 2.724 | -0.000975 | 739.2765 | 2.724 | -0.000975 |
| 740.3032 | 1.072 | 0.000976 | 740.2756 | 2.751 | 0.000808 | 740.2756 | 2.751 | 0.000808 |
| 741.2966 | 1.066 | 0.000949 | 741.2776 | 2.750 | -0.000536 | 741.2776 | 2.750 | -0.000536 |
| 742.2891 | 1.071 | -0.000394 | 742.2779 | 2.743 | -0.000286 | 742.2779 | 2.743 | -0.000286 |
| 743.2842 | 1.124 | -0.000721 | 743.2753 | 2.746 | -0.000329 | 743.2753 | 2.746 | -0.000329 |
| 744.2866 | 1.073 | 0.000683 | 744.2774 | 2.742 | -0.000135 | 744.2774 | 2.742 | -0.000135 |
| 745.2890 | 1.066 | -0.000364 | 745.2749 | 2.738 | 0.000223 | 745.2749 | 2.738 | 0.000223 |
| 746.2922 | 1.092 | -0.000196 | 746.2818 | 2.750 | -0.000313 | 746.2818 | 2.750 | -0.000313 |
| 747.2934 | 1.070 | -0.000116 | 747.2812 | 2.688 | 0.001298 | 747.2812 | 2.688 | 0.001298 |
| 748.2964 | 1.067 | 0.001180 | 748.2886 | 2.760 | -0.000293 | 748.2886 | 2.760 | -0.000293 |
| 749.2986 | 1.071 | -0.000093 | 749.2893 | 2.778 | -0.000972 | 749.2893 | 2.778 | -0.000972 |
| 750.2979 | 1.066 | 0.000436 | 750.2853 | 2.747 | 0.000353 | 750.2853 | 2.747 | 0.000353 |
| 751.2965 | 1.069 | 0.002544 | 751.2834 | 2.742 | -0.000973 | 751.2834 | 2.742 | -0.000973 |
| 752.2956 | 1.065 | -0.000004 | 752.2741 | 2.656 | -0.001248 | 752.2741 | 2.656 | -0.001248 |
| 753.2982 | 1.068 | -0.000963 | 753.2881 | 2.812 | 0.000132 | 753.2881 | 2.812 | 0.000132 |
| 754.3001 | 1.066 | -0.000324 | 754.2866 | 2.741 | 0.001156 | 754.2866 | 2.741 | 0.001156 |
| 755.3084 | 1.110 | 0.000950 | 755.2906 | 2.746 | 0.000463 | 755.2906 | 2.746 | 0.000463 |
| 756.3066 | 0.996 | -0.000403 | 756.2868 | 2.734 | -0.000077 | 756.2868 | 2.734 | -0.000077 |
| 757.3169 | 1.061 | -0.000520 | 757.2895 | 2.741 | 0.000800 | 757.2895 | 2.741 | 0.000800 |
| 758.3198 | 1.065 | -0.000504 | 758.2944 | 2.740 | 0.001721 | 758.2944 | 2.740 | 0.001721 |
| 759.3142 | 1.068 | 0.002419 | 759.2950 | 2.738 | -0.000012 | 759.2950 | 2.738 | -0.000012 |
| 760.3100 | 1.130 | 0.000436 | 760.2962 | 2.740 | -0.001242 | 760.2962 | 2.740 | -0.001242 |
| 761.3160 | 1.067 | 0.000491 | 761.2976 | 2.752 | -0.001109 | 761.2976 | 2.752 | -0.001109 |
| 762.3203 | 1.064 | -0.000971 | 762.2988 | 2.734 | -0.000826 | 762.2988 | 2.734 | -0.000826 |
| 763.3207 | 1.063 | -0.001994 | 763.2938 | 2.738 | -0.000605 | 763.2938 | 2.738 | -0.000605 |
| 764.3120 | 1.050 | -0.001418 | 764.2986 | 2.758 | -0.000351 | 764.2986 | 2.758 | -0.000351 |
| 765.3266 | 1.150 | 0.002415 | 765.3013 | 2.754 | -0.000165 | 765.3013 | 2.754 | -0.000165 |
| 766.3235 | 1.067 | 0.001513 | 766.2974 | 2.735 | 0.000253 | 766.2974 | 2.735 | 0.000253 |
| 767.3171 | 1.059 | -0.001314 | 767.2970 | 2.740 | 0.000313 | 767.2970 | 2.740 | 0.000313 |
| 768.3147 | 1.072 | -0.001880 | 768.2974 | 2.749 | 0.001494 | 768.2974 | 2.749 | 0.001494 |
| 769.3157 | 1.062 | 0.002177 | 769.2982 | 2.744 | 0.000511 | 769.2982 | 2.744 | 0.000511 |
| 770.3120 | 1.127 | 0.001627 | 770.3012 | 2.744 | 0.001693 | 770.3012 | 2.744 | 0.001693 |
| 771.3126 | 0.988 | 0.000359 | 771.2982 | 2.734 | -0.001078 | 771.2982 | 2.734 | -0.001078 |
| 772.3294 | 1.106 | 0.000196 | 772.2988 | 2.727 | -0.000476 | 772.2988 | 2.727 | -0.000476 |
| 773.3286 | 1.065 | -0.000771 | 773.2984 | 2.741 | 0.000471 | 773.2984 | 2.741 | 0.000471 |
| 774.3256 | 1.053 | -0.000378 | 774.3063 | 2.757 | 0.000521 | 774.3063 | 2.757 | 0.000521 |
| 775.3224 | 1.059 | 0.004446 | 775.2974 | 2.671 | 0.000605 | 775.2974 | 2.671 | 0.000605 |
| 776.3196 | 1.055 | 0.000646 | 776.3092 | 2.768 | 0.000400 | 776.3092 | 2.768 | 0.000400 |
| 777.3240 | 1.059 | -0.001077 | 777.3058 | 2.726 | -0.000108 | 777.3058 | 2.726 | -0.000108 |
| 778.3204 | 1.067 | -0.002275 | 778.3012 | 2.737 | 0.000347 | 778.3012 | 2.737 | 0.000347 |
| 779.3191 | 1.051 | -0.002523 | 779.3055 | 2.733 | -0.000271 | 779.3055 | 2.733 | -0.000271 |
| 780.3120 | 1.080 | -0.001612 | 780.3056 | 2.747 | 0.000842 | 780.3056 | 2.747 | 0.000842 |
| 781.3178 | 1.091 | -0.001288 | 781.3085 | 2.753 | -0.000614 | 781.3085 | 2.753 | -0.000614 |
| 782.3155 | 1.057 | -0.000803 | 782.3098 | 2.746 | -0.001027 | 782.3098 | 2.746 | -0.001027 |
| 783.3144 | 1.082 | -0.001163 | 783.3138 | 2.739 | 0.001943 | 783.3138 | 2.739 | 0.001943 |
| 784.3151 | 1.055 | -0.000636 | 784.3112 | 2.741 | -0.000188 | 784.3112 | 2.741 | -0.000188 |
| 785.3176 | 1.050 | 0.003681 | 785.3085 | 2.746 | -0.000661 | 785.3085 | 2.746 | -0.000661 |
| 786.3191 | 1.076 | 0.001292 | 786.3134 | 2.726 | -0.000763 | 786.3134 | 2.726 | -0.000763 |
| 787.3248 | 1.059 | 0.000556 | 787.3144 | 2.744 | -0.001851 | 787.3144 | 2.744 | -0.001851 |
| 788.3255 | 1.053 | 0.000611 | 788.3131 | 2.761 | -0.002106 | 788.3131 | 2.761 | -0.002106 |
| 789.3266 | 1.056 | -0.000220 | 789.3306 | 2.796 | -0.001423 | 789.3306 | 2.796 | -0.001423 |
| 790.3334 | 1.019 | 0.000171 | 790.3276 | 2.754 | -0.000689 | 790.3276 | 2.754 | -0.000689 |
| 791.3332 | 1.094 | 0.001733 | 791.3149 | 2.745 | -0.000506 | 791.3149 | 2.745 | -0.000506 |
| 792.3306 | 1.050 | -0.000690 | 792.3164 | 2.770 | 0.000556 | 792.3164 | 2.770 | 0.000556 |

Table B-1: Continued

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 793.3322 | 1.072 | 0.001043 | 793.3170 | 2.730 | 0.003889 | 793.3170 | 2.730 | 0.003889 |
| 794.3300 | 1.066 | -0.001496 | 794.3160 | 2.735 | 0.003189 | 794.3160 | 2.735 | 0.003189 |
| 795.3330 | 1.065 | -0.001374 | 795.3176 | 2.730 | 0.001385 | 795.3176 | 2.730 | 0.001385 |
| 796.3262 | 0.968 | -0.000222 | 796.3188 | 2.735 | -0.000581 | 796.3188 | 2.735 | -0.000581 |
| 797.3318 | 1.079 | -0.000087 | 797.3188 | 2.724 | -0.000866 | 797.3188 | 2.724 | -0.000866 |
| 798.3285 | 0.954 | 0.000037 | 798.3194 | 2.738 | -0.001343 | 798.3194 | 2.738 | -0.001343 |
| 799.3419 | 1.069 | -0.000315 | 799.3132 | 2.657 | -0.001171 | 799.3132 | 2.657 | -0.001171 |
| 800.3408 | 1.065 | -0.000414 | 800.3232 | 2.798 | -0.000988 | 800.3232 | 2.798 | -0.000988 |
| 801.3424 | 1.063 | 0.000487 | 801.3269 | 2.739 | 0.000206 | 801.3269 | 2.739 | 0.000206 |
| 802.3412 | 1.058 | 0.000200 | 802.3222 | 2.745 | -0.000290 | 802.3222 | 2.745 | -0.000290 |
| 803.3434 | 1.068 | 0.001382 | 803.3209 | 2.748 | -0.000440 | 803.3209 | 2.748 | -0.000440 |
| 804.3458 | 1.066 | 0.000728 | 804.3212 | 2.736 | -0.000601 | 804.3212 | 2.736 | -0.000601 |
| 805.3450 | 1.060 | 0.000719 | 805.3262 | 2.743 | 0.001189 | 805.3262 | 2.743 | 0.001189 |
| 806.3451 | 1.080 | 0.000549 | 806.3301 | 2.792 | -0.000757 | 806.3301 | 2.792 | -0.000757 |
| 807.3418 | 1.061 | 0.000540 | 807.3286 | 2.747 | -0.000435 | 807.3286 | 2.747 | -0.000435 |
| 808.3403 | 1.055 | 0.000363 | 808.3326 | 2.752 | 0.001393 | 808.3326 | 2.752 | 0.001393 |
| 809.3403 | 1.066 | -0.000108 | 809.3290 | 2.741 | -0.000332 | 809.3290 | 2.741 | -0.000332 |
| 810.3422 | 1.055 | -0.000258 | 810.3268 | 2.740 | -0.000011 | 810.3268 | 2.740 | -0.000011 |
| 811.3431 | 1.068 | 0.000136 | 811.3292 | 2.745 | 0.002269 | 811.3292 | 2.745 | 0.002269 |
| 812.3425 | 1.064 | 0.000748 | 812.3321 | 2.723 | 0.000377 | 812.3321 | 2.723 | 0.000377 |
| 813.3395 | 1.075 | 0.000963 | 813.3278 | 2.667 | -0.000183 | 813.3278 | 2.667 | -0.000183 |
| 814.3419 | 1.076 | 0.000772 | 814.3366 | 2.742 | -0.001160 | 814.3366 | 2.742 | -0.001160 |
| 815.3428 | 1.049 | 0.000467 | 815.3332 | 2.740 | 0.000651 | 815.3332 | 2.740 | 0.000651 |
| 816.3432 | 1.065 | -0.000388 | 816.3340 | 2.743 | 0.001173 | 816.3340 | 2.743 | 0.001173 |
| 817.3402 | 1.039 | -0.000710 | 817.3326 | 2.747 | -0.001268 | 817.3326 | 2.747 | -0.001268 |
| 818.3400 | 1.069 | -0.000330 | 818.3372 | 2.750 | -0.000135 | 818.3372 | 2.750 | -0.000135 |
| 819.3439 | 1.060 | -0.000488 | 819.3425 | 2.763 | -0.000945 | 819.3425 | 2.763 | -0.000945 |
| 820.3378 | 1.067 | -0.000313 | 820.3381 | 2.655 | -0.000327 | 820.3381 | 2.655 | -0.000327 |
| 821.3390 | 1.075 | 0.000697 | 821.3491 | 2.796 | 0.000402 | 821.3491 | 2.796 | 0.000402 |
| 822.3351 | 1.049 | 0.003194 | 822.3598 | 2.746 | -0.000130 | 822.3598 | 2.746 | -0.000130 |
| 823.3306 | 1.044 | 0.001313 | 823.3520 | 2.743 | -0.000241 | 823.3520 | 2.743 | -0.000241 |
| 824.3356 | 1.073 | 0.000901 | 824.3522 | 2.742 | -0.000565 | 824.3522 | 2.742 | -0.000565 |
| 825.3388 | 1.118 | 0.000644 | 825.3476 | 2.731 | -0.000163 | 825.3476 | 2.731 | -0.000163 |
| 826.3394 | 1.051 | -0.000285 | 826.3524 | 2.739 | 0.001633 | 826.3524 | 2.739 | 0.001633 |
| 827.3320 | 0.999 | -0.000866 | 827.3538 | 2.745 | -0.000769 | 827.3538 | 2.745 | -0.000769 |
| 828.3431 | 1.075 | -0.000935 | 828.3556 | 2.744 | -0.001028 | 828.3556 | 2.744 | -0.001028 |
| 829.3469 | 1.035 | -0.001452 | 829.3569 | 2.746 | -0.000823 | 829.3569 | 2.746 | -0.000823 |
| 830.3488 | 1.059 | -0.001110 | 830.3538 | 2.760 | -0.000453 | 830.3538 | 2.760 | -0.000453 |
| 831.3472 | 1.043 | -0.001597 | 831.3532 | 2.729 | 0.000348 | 831.3532 | 2.729 | 0.000348 |
| 832.3539 | 1.059 | 0.001256 | 832.3524 | 2.748 | -0.000487 | 832.3524 | 2.748 | -0.000487 |
| 833.3504 | 1.056 | -0.001192 | 833.3539 | 2.751 | 0.000048 | 833.3539 | 2.751 | 0.000048 |
| 834.3524 | 1.071 | -0.001267 | 834.3556 | 2.743 | 0.000933 | 834.3556 | 2.743 | 0.000933 |
| 835.3508 | 1.055 | -0.000522 | 835.3519 | 2.754 | 0.001172 | 835.3519 | 2.754 | 0.001172 |
| 836.3579 | 1.061 | -0.000270 | 836.3519 | 2.746 | 0.000453 | 836.3519 | 2.746 | 0.000453 |
| 837.3640 | 0.979 | 0.000905 | 837.3545 | 2.761 | -0.000096 | 837.3545 | 2.761 | -0.000096 |
| 838.3731 | 1.083 | 0.001031 | 838.3530 | 2.730 | -0.000233 | 838.3530 | 2.730 | -0.000233 |
| 839.3681 | 1.069 | 0.000846 | 839.3504 | 2.739 | -0.000349 | 839.3504 | 2.739 | -0.000349 |
| 840.3653 | 1.067 | -0.000176 | 840.3558 | 2.744 | 0.000542 | 840.3558 | 2.744 | 0.000542 |
| 841.3626 | 1.057 | -0.000678 | 841.3582 | 2.757 | 0.002412 | 841.3582 | 2.757 | 0.002412 |
| 842.3702 | 1.062 | -0.001845 | 842.3588 | 2.750 | 0.000138 | 842.3588 | 2.750 | 0.000138 |
| 843.3684 | 1.055 | -0.001256 | 843.3585 | 2.735 | 0.000267 | 843.3585 | 2.735 | 0.000267 |
| 844.3681 | 1.057 | -0.001714 | 844.3586 | 2.727 | 0.000676 | 844.3586 | 2.727 | 0.000676 |
| 845.3658 | 1.064 | -0.001729 | 845.3634 | 2.737 | 0.000831 | 845.3634 | 2.737 | 0.000831 |
| 846.3681 | 1.070 | -0.001553 | 846.3578 | 2.630 | 0.000427 | 846.3578 | 2.630 | 0.000427 |
| 847.3681 | 1.105 | -0.000191 | 847.3651 | 2.749 | -0.000660 | 847.3651 | 2.749 | -0.000660 |
| 848.3647 | 1.054 | -0.000178 | 848.3640 | 2.728 | -0.000975 | 848.3640 | 2.728 | -0.000975 |
| 849.3688 | 1.060 | 0.001266 | 849.3594 | 2.741 | -0.001152 | 849.3594 | 2.741 | -0.001152 |
| 850.3696 | 1.068 | 0.004224 | 850.3590 | 2.745 | -0.000158 | 850.3590 | 2.745 | -0.000158 |
| 851.3672 | 1.073 | 0.002334 | 851.3590 | 2.747 | -0.000297 | 851.3590 | 2.747 | -0.000297 |
| 852.3658 | 1.056 | 0.001400 | 852.3581 | 2.749 | 0.001190 | 852.3581 | 2.749 | 0.001190 |
| 853.3639 | 1.071 | 0.001172 | 853.3631 | 2.743 | -0.000658 | 853.3631 | 2.743 | -0.000658 |
| 854.3670 | 1.056 | 0.000751 | 854.3542 | 2.735 | -0.000837 | 854.3542 | 2.735 | -0.000837 |
| 855.3630 | 1.079 | 0.000224 | 855.3585 | 2.738 | -0.000967 | 855.3585 | 2.738 | -0.000967 |
| 856.3759 | 1.061 | -0.000863 | 856.3653 | 2.763 | 0.000016 | 856.3653 | 2.763 | 0.000016 |
| 857.3746 | 1.050 | -0.000787 | 857.3676 | 2.790 | 0.000621 | 857.3676 | 2.790 | 0.000621 |
| 858.3801 | 1.059 | -0.001339 | 858.3728 | 2.765 | -0.000763 | 858.3728 | 2.765 | -0.000763 |
| 859.3829 | 1.049 | -0.000748 | 859.3701 | 2.742 | 0.000134 | 859.3701 | 2.742 | 0.000134 |

Table B-1: Continued

| Pure PMMA, 10 C/min | | | 1wt% silica in PMMA, 10C/min | | | 2wt% silica in PMMA, 10C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 860.3796 | 1.044 | 0.001537 | 860.3710 | 2.737 | 0.000410 | 860.3710 | 2.737 | 0.000410 |
| 861.3856 | 1.072 | 0.000212 | 861.3634 | 2.660 | -0.000353 | 861.3634 | 2.660 | -0.000353 |
| 862.3882 | 1.066 | 0.000206 | 862.3768 | 2.811 | 0.001752 | 862.3768 | 2.811 | 0.001752 |
| 863.3880 | 1.056 | -0.000053 | 863.3732 | 2.715 | -0.000044 | 863.3732 | 2.715 | -0.000044 |
| 864.3869 | 1.068 | -0.000125 | 864.3678 | 2.734 | -0.000802 | 864.3678 | 2.734 | -0.000802 |
| 865.3844 | 1.073 | -0.000438 | 865.3662 | 2.744 | -0.000686 | 865.3662 | 2.744 | -0.000686 |
| 866.3839 | 1.060 | -0.000813 | 866.3728 | 2.758 | -0.000889 | 866.3728 | 2.758 | -0.000889 |
| 867.3836 | 1.048 | -0.000754 | 867.3641 | 2.744 | 0.001746 | 867.3641 | 2.744 | 0.001746 |
| 868.3876 | 1.054 | 0.001422 | 868.3641 | 2.742 | -0.000617 | 868.3641 | 2.742 | -0.000617 |
| 869.3925 | 1.073 | -0.000361 | 869.3637 | 2.741 | 0.000386 | 869.3637 | 2.741 | 0.000386 |
| 870.3891 | 1.077 | 0.001193 | 870.3634 | 2.735 | 0.000485 | 870.3634 | 2.735 | 0.000485 |
| 871.3930 | 1.046 | -0.000334 | 871.3682 | 2.767 | 0.000481 | 871.3682 | 2.767 | 0.000481 |
| 872.3942 | 1.062 | 0.000243 | 872.3641 | 2.732 | -0.000200 | 872.3641 | 2.732 | -0.000200 |
| 873.3830 | 0.944 | 0.000562 | 873.3808 | 2.752 | 0.000554 | 873.3808 | 2.752 | 0.000554 |
| 874.3895 | 1.083 | 0.000850 | 874.3828 | 2.750 | 0.000783 | 874.3828 | 2.750 | 0.000783 |
| 875.3881 | 1.122 | 0.001100 | 875.3881 | 2.738 | 0.001651 | 875.3881 | 2.738 | 0.001651 |
| 876.3931 | 1.069 | 0.000851 | 876.3869 | 2.746 | 0.001699 | 876.3869 | 2.746 | 0.001699 |
| 877.3884 | 1.062 | 0.000490 | 877.3855 | 2.739 | 0.000652 | 877.3855 | 2.739 | 0.000652 |
| 878.3830 | 1.052 | 0.000718 | 878.3812 | 2.721 | 0.000102 | 878.3812 | 2.721 | 0.000102 |
| 879.3849 | 1.063 | -0.000098 | 879.3860 | 2.729 | -0.000470 | 879.3860 | 2.729 | -0.000470 |
| 880.3859 | 1.043 | 0.002969 | 880.3872 | 2.739 | -0.001246 | 880.3872 | 2.739 | -0.001246 |
| 881.3864 | 1.059 | 0.000591 | 881.3889 | 2.743 | -0.001398 | 881.3889 | 2.743 | -0.001398 |
| 882.3894 | 1.045 | -0.000387 | 882.3858 | 2.745 | -0.002194 | 882.3858 | 2.745 | -0.002194 |
| 883.3905 | 1.067 | -0.000865 | 883.3874 | 2.744 | -0.001052 | 883.3874 | 2.744 | -0.001052 |
| 884.3862 | 1.045 | -0.001315 | 884.3872 | 2.748 | -0.001289 | 884.3872 | 2.748 | -0.001289 |
| 885.3886 | 1.044 | -0.000092 | 885.3863 | 2.761 | -0.000290 | 885.3863 | 2.761 | -0.000290 |
| 886.3975 | 1.065 | 0.000061 | 886.3864 | 2.742 | -0.000252 | 886.3864 | 2.742 | -0.000252 |
| 887.3981 | 1.078 | 0.000200 | 887.3855 | 2.737 | -0.000638 | 887.3855 | 2.737 | -0.000638 |
| 888.3953 | 1.061 | 0.000243 | 888.3882 | 2.783 | -0.000045 | 888.3882 | 2.783 | -0.000045 |
| 889.3918 | 1.065 | -0.000231 | 889.3891 | 2.755 | 0.000095 | 889.3891 | 2.755 | 0.000095 |
| 890.3937 | 1.047 | 0.000801 | 890.3908 | 2.735 | 0.000152 | 890.3908 | 2.735 | 0.000152 |
| 891.3966 | 1.055 | 0.001181 | 891.3845 | 2.747 | -0.000124 | 891.3845 | 2.747 | -0.000124 |
| 892.3928 | 1.056 | 0.001479 | 892.3863 | 2.740 | -0.000171 | 892.3863 | 2.740 | -0.000171 |
| 893.3981 | 1.074 | 0.000114 | 893.3886 | 2.735 | 0.002442 | 893.3886 | 2.735 | 0.002442 |
| 894.3939 | 1.042 | -0.000462 | 894.3914 | 2.751 | 0.001550 | 894.3914 | 2.751 | 0.001550 |
| 895.3994 | 1.057 | 0.002960 | 895.3878 | 2.737 | 0.002847 | 895.3878 | 2.737 | 0.002847 |

Table B-2: TGA and DTG for 4wt% silica (10C/min), pure PMMA (20C/min) and 1wt% silica (20C/min)

| 4wt% silica in PMMA, 10C/min | | | Pure PMMA, 20C/min | | | 1wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 200.0296 | 100.000 | 0.013906 | 200.0585 | 100.000 | 0.016288 | 200.1186 | 100.000 | 0.018766 |
| 201.0314 | 99.993 | 0.014568 | 202.0520 | 99.966 | 0.016125 | 202.1170 | 99.962 | 0.020159 |
| 202.0326 | 99.987 | 0.013395 | 204.0517 | 99.938 | 0.015579 | 204.1083 | 99.909 | 0.011111 |
| 203.0184 | 99.888 | 0.013617 | 206.0416 | 99.904 | 0.015002 | 206.1189 | 99.922 | 0.009000 |
| 204.0310 | 99.940 | 0.013440 | 208.0481 | 99.876 | 0.014451 | 208.1183 | 99.990 | 0.010223 |
| 205.0306 | 99.918 | 0.013620 | 210.0426 | 99.850 | 0.014376 | 210.1194 | 99.845 | 0.015973 |
| 206.0288 | 99.909 | 0.012962 | 212.0380 | 99.821 | 0.012660 | 212.1165 | 99.823 | 0.013154 |
| 207.0277 | 99.904 | 0.012734 | 214.0246 | 99.741 | 0.012542 | 214.1188 | 99.797 | 0.011375 |
| 208.0256 | 99.892 | 0.013962 | 216.0384 | 99.775 | 0.012479 | 216.1152 | 99.773 | 0.009921 |
| 209.0270 | 99.875 | 0.011716 | 218.0370 | 99.740 | 0.011870 | 218.1138 | 99.772 | 0.012566 |
| 210.0240 | 99.857 | 0.011851 | 220.0318 | 99.726 | 0.014073 | 220.1110 | 99.743 | 0.011394 |
| 211.0230 | 99.846 | 0.011880 | 222.0361 | 99.690 | 0.012408 | 222.1050 | 99.686 | 0.010323 |
| 212.0240 | 99.837 | 0.011725 | 224.0342 | 99.666 | 0.012426 | 224.1050 | 99.674 | 0.011442 |
| 213.0127 | 99.787 | 0.011447 | 226.0316 | 99.633 | 0.014525 | 226.1100 | 99.690 | 0.008692 |
| 214.0241 | 99.822 | 0.010673 | 228.0289 | 99.608 | 0.014295 | 228.1072 | 99.620 | 0.008930 |
| 215.0230 | 99.804 | 0.010398 | 230.0258 | 99.577 | 0.014707 | 230.1067 | 99.644 | 0.010026 |
| 216.0209 | 99.790 | 0.010820 | 232.0196 | 99.555 | 0.015844 | 232.1043 | 99.618 | 0.010246 |
| 217.0200 | 99.789 | 0.010815 | 234.0195 | 99.520 | 0.013142 | 234.1006 | 99.557 | 0.011143 |
| 218.0197 | 99.774 | 0.011451 | 236.0082 | 99.471 | 0.013494 | 236.1018 | 99.549 | 0.009034 |
| 219.0204 | 99.763 | 0.010480 | 238.0159 | 99.485 | 0.017369 | 238.0976 | 99.528 | 0.010934 |
| 220.0188 | 99.754 | 0.010448 | 240.0190 | 99.431 | 0.016045 | 240.0993 | 99.548 | 0.016882 |
| 221.0196 | 99.737 | 0.010633 | 242.0054 | 99.341 | 0.019253 | 242.0978 | 99.474 | 0.014437 |
| 222.0201 | 99.729 | 0.010965 | 244.0029 | 99.348 | 0.018170 | 244.0994 | 99.426 | 0.021635 |
| 223.0190 | 99.719 | 0.011991 | 246.0210 | 99.324 | 0.019693 | 246.0984 | 99.471 | 0.027688 |
| 224.0208 | 99.712 | 0.011088 | 248.0230 | 99.262 | 0.026173 | 248.0998 | 99.341 | 0.025240 |
| 225.0196 | 99.701 | 0.010347 | 250.0204 | 99.217 | 0.029803 | 250.0879 | 99.097 | 0.030080 |
| 226.0169 | 99.683 | 0.010591 | 252.0186 | 99.165 | 0.029573 | 252.1012 | 99.289 | 0.030871 |
| 227.0147 | 99.674 | 0.010847 | 254.0213 | 99.093 | 0.032846 | 254.1042 | 99.190 | 0.041307 |
| 228.0065 | 99.602 | 0.010874 | 256.0194 | 99.029 | 0.037693 | 256.1074 | 99.084 | 0.050166 |
| 229.0132 | 99.678 | 0.010782 | 258.0198 | 98.954 | 0.039559 | 258.0929 | 98.869 | 0.054586 |
| 230.0196 | 99.650 | 0.011078 | 260.0035 | 98.808 | 0.044507 | 260.1116 | 98.922 | 0.060598 |
| 231.0165 | 99.632 | 0.011497 | 262.0182 | 98.791 | 0.050201 | 262.1087 | 98.718 | 0.068965 |
| 232.0164 | 99.620 | 0.012243 | 264.0160 | 98.610 | 0.056561 | 264.1134 | 98.559 | 0.091529 |
| 233.0163 | 99.608 | 0.013018 | 266.0263 | 98.541 | 0.065019 | 266.1213 | 98.408 | 0.099387 |
| 234.0163 | 99.599 | 0.014268 | 268.0358 | 98.425 | 0.072087 | 268.1162 | 98.142 | 0.119077 |
| 235.0130 | 99.580 | 0.014388 | 270.0416 | 98.288 | 0.084384 | 270.1201 | 97.909 | 0.138603 |
| 236.0080 | 99.567 | 0.015386 | 272.0515 | 98.082 | 0.100252 | 272.1218 | 97.592 | 0.158859 |
| 237.0067 | 99.548 | 0.016236 | 274.0628 | 97.870 | 0.117305 | 274.1287 | 97.284 | 0.185131 |
| 238.0134 | 99.549 | 0.015576 | 276.0795 | 97.612 | 0.137358 | 276.1362 | 96.887 | 0.211056 |
| 239.0130 | 99.511 | 0.015894 | 278.0994 | 97.323 | 0.162052 | 278.1471 | 96.447 | 0.245947 |
| 240.0102 | 99.505 | 0.018086 | 280.1168 | 96.974 | 0.191428 | 280.1644 | 95.941 | 0.291558 |
| 240.9996 | 99.441 | 0.017185 | 282.1360 | 96.559 | 0.225680 | 282.1742 | 95.310 | 0.333773 |
| 242.0065 | 99.507 | 0.017846 | 284.1531 | 96.069 | 0.263736 | 284.1878 | 94.539 | 0.386560 |
| 243.0070 | 99.449 | 0.018603 | 286.1715 | 95.499 | 0.305927 | 286.2127 | 93.784 | 0.443102 |
| 244.0124 | 99.432 | 0.019594 | 288.1920 | 94.843 | 0.351203 | 288.2356 | 92.803 | 0.500626 |
| 245.0004 | 99.375 | 0.021048 | 290.2156 | 94.087 | 0.402443 | 290.2537 | 91.725 | 0.569411 |
| 246.0107 | 99.395 | 0.022619 | 292.2444 | 93.232 | 0.457222 | 292.2712 | 90.558 | 0.629559 |
| 247.0122 | 99.365 | 0.025660 | 294.2674 | 92.238 | 0.515806 | 294.2935 | 89.189 | 0.688060 |
| 248.0119 | 99.340 | 0.025785 | 296.2938 | 91.139 | 0.577630 | 296.3014 | 87.697 | 0.743499 |
| 249.0073 | 99.313 | 0.027489 | 298.3241 | 89.905 | 0.639463 | 298.3102 | 86.199 | 0.793098 |
| 250.0014 | 99.283 | 0.031105 | 300.3477 | 88.542 | 0.705206 | 300.3120 | 84.552 | 0.850641 |
| 251.0068 | 99.255 | 0.033512 | 302.3696 | 87.071 | 0.771948 | 302.3142 | 82.813 | 0.886233 |
| 252.0066 | 99.222 | 0.034674 | 304.3814 | 85.433 | 0.848257 | 304.2943 | 80.763 | 0.926137 |
| 253.0043 | 99.191 | 0.037133 | 306.3800 | 83.686 | 0.926197 | 306.3194 | 79.231 | 0.959089 |
| 254.0036 | 99.144 | 0.040498 | 308.3736 | 81.754 | 0.997066 | 308.3086 | 77.090 | 0.977482 |
| 255.0065 | 99.105 | 0.044405 | 310.3512 | 79.676 | 1.059996 | 310.3148 | 75.178 | 1.002830 |
| 255.9920 | 98.985 | 0.048534 | 312.3238 | 77.542 | 1.094969 | 312.2660 | 73.192 | 1.011601 |
| 257.0074 | 99.026 | 0.053293 | 314.2365 | 75.327 | 1.109292 | 314.2538 | 71.180 | 1.023558 |
| 258.0074 | 98.961 | 0.058230 | 316.2485 | 73.177 | 1.107305 | 316.2470 | 69.100 | 1.025480 |
| 259.0106 | 98.897 | 0.064352 | 318.2704 | 70.868 | 1.118780 | 318.2002 | 67.063 | 1.050015 |
| 260.0108 | 98.833 | 0.071273 | 320.3305 | 68.644 | 1.140655 | 320.1940 | 65.105 | 1.059038 |
| 261.0100 | 98.758 | 0.079391 | 322.3330 | 66.201 | 1.142543 | 322.2138 | 62.881 | 1.078054 |
| 262.0140 | 98.681 | 0.088171 | 324.3384 | 63.954 | 1.172225 | 324.1899 | 60.818 | 1.098670 |
| 263.0170 | 98.592 | 0.097769 | 326.3254 | 61.847 | 1.166658 | 326.2625 | 58.460 | 1.099568 |
| 264.0119 | 98.456 | 0.109375 | 328.3590 | 59.137 | 1.155545 | 328.1974 | 56.316 | 1.091679 |
| 265.0213 | 98.394 | 0.123921 | 330.3172 | 56.979 | 1.182377 | 330.1645 | 54.061 | 1.086538 |
| 266.0238 | 98.252 | 0.137740 | 332.2321 | 54.938 | 1.178147 | 332.1748 | 51.987 | 1.066254 |

Table B-2: Continued

| 4wt% silica in PMMA, 10C/min | | | Pure PMMA, 20C/min | | | 1wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 267.0284 | 98.113 | 0.154783 | 334.3032 | 52.112 | 1.173036 | 334.1447 | 49.862 | 1.047043 |
| 268.0358 | 97.952 | 0.173282 | 336.2316 | 49.948 | 1.158642 | 336.1243 | 47.783 | 1.033146 |
| 269.0402 | 97.774 | 0.194925 | 338.1485 | 47.770 | 1.131089 | 338.1697 | 45.768 | 1.011851 |
| 270.0400 | 97.590 | 0.220196 | 340.2631 | 45.557 | 1.122841 | 340.0913 | 43.769 | 1.001335 |
| 271.0525 | 97.346 | 0.244580 | 342.2137 | 43.185 | 1.117824 | 342.0950 | 41.852 | 0.983982 |
| 272.0598 | 97.086 | 0.272286 | 344.2160 | 41.008 | 1.094575 | 344.0938 | 39.794 | 0.959391 |
| 273.0684 | 96.797 | 0.301496 | 346.1919 | 38.897 | 1.049331 | 346.0660 | 37.963 | 0.931223 |
| 274.0740 | 96.484 | 0.332221 | 348.1549 | 36.872 | 1.020406 | 348.0735 | 36.150 | 0.901036 |
| 275.0786 | 96.162 | 0.365989 | 350.1289 | 34.895 | 0.989653 | 350.0667 | 34.390 | 0.877313 |
| 276.0884 | 95.757 | 0.397897 | 352.0789 | 32.988 | 0.959509 | 352.0546 | 32.648 | 0.857536 |
| 277.0950 | 95.337 | 0.432263 | 354.0528 | 31.120 | 0.926634 | 354.0594 | 30.925 | 0.833132 |
| 278.0988 | 94.890 | 0.464750 | 356.0094 | 29.333 | 0.894967 | 356.0733 | 29.308 | 0.808697 |
| 279.1045 | 94.407 | 0.497670 | 357.9872 | 27.611 | 0.867184 | 358.0613 | 27.578 | 0.789966 |
| 280.0989 | 93.885 | 0.531165 | 359.9958 | 25.896 | 0.844555 | 360.0824 | 26.137 | 0.769787 |
| 281.0953 | 93.339 | 0.560866 | 361.9925 | 24.233 | 0.824111 | 362.0771 | 24.604 | 0.747699 |
| 282.0940 | 92.765 | 0.588856 | 363.9811 | 22.609 | 0.807637 | 364.0678 | 23.149 | 0.729347 |
| 283.0856 | 92.159 | 0.616631 | 366.0460 | 20.983 | 0.794760 | 366.0603 | 21.737 | 0.699229 |
| 284.0828 | 91.528 | 0.642486 | 368.1099 | 19.348 | 0.788361 | 368.0411 | 20.347 | 0.674857 |
| 285.0770 | 90.867 | 0.666793 | 370.1415 | 17.747 | 0.783969 | 370.0290 | 19.026 | 0.650694 |
| 286.0750 | 90.190 | 0.690273 | 372.1428 | 16.176 | 0.774231 | 372.0179 | 17.770 | 0.624839 |
| 287.0689 | 89.491 | 0.712152 | 374.1080 | 14.662 | 0.756265 | 374.0055 | 16.554 | 0.597000 |
| 288.0681 | 88.766 | 0.732983 | 376.0456 | 13.207 | 0.730178 | 375.9931 | 15.390 | 0.570705 |
| 289.0632 | 88.030 | 0.754508 | 377.9534 | 11.836 | 0.697393 | 377.9888 | 14.350 | 0.552668 |
| 290.0624 | 87.261 | 0.772033 | 379.8472 | 10.542 | 0.655963 | 379.9804 | 13.230 | 0.527306 |
| 291.0588 | 86.479 | 0.790396 | 381.7298 | 9.341 | 0.608686 | 381.9774 | 12.239 | 0.491696 |
| 292.0540 | 85.682 | 0.808201 | 383.6088 | 8.240 | 0.557249 | 383.9506 | 11.217 | 0.464564 |
| 293.0503 | 84.862 | 0.825463 | 385.5017 | 7.236 | 0.503556 | 385.9673 | 10.434 | 0.439003 |
| 294.0362 | 83.982 | 0.841559 | 387.4072 | 6.329 | 0.450521 | 387.9595 | 9.496 | 0.426027 |
| 295.0526 | 83.193 | 0.858259 | 389.3284 | 5.516 | 0.401285 | 389.9458 | 8.686 | 0.411955 |
| 296.0520 | 82.312 | 0.873984 | 391.2619 | 4.794 | 0.353175 | 391.9294 | 7.917 | 0.358534 |
| 297.0508 | 81.430 | 0.888777 | 393.2141 | 4.158 | 0.307124 | 393.8838 | 7.125 | 0.324156 |
| 298.0448 | 80.515 | 0.902579 | 395.1848 | 3.593 | 0.267879 | 395.8716 | 6.756 | 0.288481 |
| 299.0483 | 79.626 | 0.916251 | 397.1759 | 3.108 | 0.229637 | 397.8461 | 6.087 | 0.258470 |
| 300.0462 | 78.692 | 0.924438 | 399.1780 | 2.684 | 0.195088 | 399.8285 | 5.599 | 0.235016 |
| 301.0450 | 77.760 | 0.930020 | 401.2104 | 2.330 | 0.163331 | 401.8198 | 5.200 | 0.192960 |
| 302.0471 | 76.813 | 0.935673 | 403.2246 | 2.024 | 0.133271 | 403.8261 | 4.818 | 0.161626 |
| 303.0409 | 75.866 | 0.936429 | 405.2160 | 1.778 | 0.105674 | 405.8375 | 4.549 | 0.133403 |
| 304.0407 | 74.927 | 0.937645 | 407.2152 | 1.610 | 0.079815 | 407.8613 | 4.294 | 0.107832 |
| 305.0359 | 74.006 | 0.938124 | 409.2746 | 1.482 | 0.055509 | 409.8873 | 4.135 | 0.084782 |
| 306.0453 | 73.071 | 0.939303 | 411.3819 | 1.389 | 0.037777 | 411.9187 | 3.958 | 0.068656 |
| 307.0466 | 72.189 | 0.941024 | 413.5210 | 1.328 | 0.024500 | 413.9460 | 3.860 | 0.044890 |
| 308.0476 | 71.189 | 0.942604 | 415.6768 | 1.292 | 0.014436 | 415.9861 | 3.792 | 0.027228 |
| 309.0503 | 70.241 | 0.945599 | 417.8520 | 1.272 | 0.008527 | 418.0478 | 3.893 | 0.018708 |
| 310.0457 | 69.286 | 0.948475 | 420.0198 | 1.262 | 0.005142 | 420.1093 | 3.718 | 0.013430 |
| 311.0380 | 68.335 | 0.950976 | 422.1574 | 1.250 | 0.003584 | 422.1676 | 3.698 | 0.005315 |
| 312.0415 | 67.421 | 0.955383 | 424.2556 | 1.247 | 0.002863 | 424.1981 | 3.559 | 0.007899 |
| 313.0413 | 66.434 | 0.954025 | 426.3153 | 1.243 | 0.002314 | 426.2596 | 3.727 | -0.004440 |
| 314.0378 | 65.476 | 0.952326 | 428.3408 | 1.237 | 0.002196 | 428.2701 | 3.655 | -0.005153 |
| 315.0404 | 64.518 | 0.950461 | 430.3487 | 1.233 | 0.001405 | 430.2954 | 3.765 | 0.008352 |
| 316.0221 | 63.572 | 0.948661 | 432.3418 | 1.230 | 0.001638 | 432.2953 | 3.654 | -0.001324 |
| 317.0149 | 62.630 | 0.948988 | 434.3285 | 1.227 | 0.001700 | 434.2922 | 3.652 | 0.007809 |
| 318.0248 | 61.681 | 0.948999 | 436.3217 | 1.227 | 0.001437 | 436.2838 | 3.642 | 0.001410 |
| 319.0335 | 60.757 | 0.952026 | 438.2992 | 1.220 | 0.001521 | 438.2768 | 3.653 | 0.001280 |
| 320.0332 | 59.790 | 0.956389 | 440.2873 | 1.220 | 0.000896 | 440.2660 | 3.635 | -0.001052 |
| 321.0399 | 58.849 | 0.963847 | 442.2646 | 1.144 | -0.000092 | 442.2610 | 3.638 | -0.001163 |
| 322.0512 | 57.861 | 0.970750 | 444.2728 | 1.223 | 0.000689 | 444.2540 | 3.769 | 0.000768 |
| 323.0446 | 56.821 | 0.976817 | 446.2690 | 1.220 | 0.000630 | 446.2584 | 3.636 | 0.007843 |
| 324.0580 | 55.886 | 0.980698 | 448.2537 | 1.209 | 0.002510 | 448.2513 | 3.632 | -0.003523 |
| 325.0534 | 54.892 | 0.982594 | 450.2422 | 1.210 | 0.001791 | 450.2480 | 3.627 | -0.003017 |
| 326.0488 | 53.943 | 0.982723 | 452.2337 | 1.208 | 0.000059 | 452.2491 | 3.785 | -0.004302 |
| 327.0409 | 52.929 | 0.980699 | 454.2228 | 1.204 | 0.002104 | 454.2465 | 3.657 | -0.002516 |
| 328.0342 | 51.962 | 0.974817 | 456.2168 | 1.209 | -0.000269 | 456.2419 | 3.634 | 0.013555 |
| 329.0292 | 50.992 | 0.970250 | 458.2096 | 1.173 | -0.000678 | 458.2350 | 3.635 | 0.002028 |
| 330.0236 | 50.025 | 0.964585 | 460.2120 | 1.221 | -0.000164 | 460.2324 | 3.643 | -0.000629 |
| 331.0073 | 49.060 | 0.959810 | 462.2060 | 1.205 | -0.000126 | 462.2293 | 3.776 | -0.003784 |
| 331.9995 | 48.154 | 0.952319 | 464.2008 | 1.202 | 0.003246 | 464.2275 | 3.624 | -0.004187 |
| 333.0012 | 47.189 | 0.945131 | 466.1934 | 1.199 | 0.000586 | 466.2282 | 3.634 | 0.000764 |

Table B-2: Continued

| 4wt% silica in PMMA, 10C/min | | | Pure PMMA, 20C/min | | | 1wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 333.9946 | 46.235 | 0.937173 | 468.1904 | 1.201 | 0.000296 | 468.2254 | 3.625 | -0.000992 |
| 334.9956 | 45.300 | 0.929665 | 470.1841 | 1.200 | 0.000191 | 470.2220 | 3.645 | -0.000043 |
| 335.9931 | 44.376 | 0.923158 | 472.1796 | 1.198 | 0.000337 | 472.2236 | 3.647 | -0.000042 |
| 336.9961 | 43.462 | 0.918110 | 474.1794 | 1.200 | 0.000362 | 474.2271 | 3.632 | 0.004400 |
| 337.9988 | 42.550 | 0.909765 | 476.1799 | 1.197 | 0.000196 | 476.2332 | 3.650 | -0.003446 |
| 339.0043 | 41.642 | 0.902735 | 478.1806 | 1.198 | 0.000245 | 478.2290 | 3.727 | -0.008909 |
| 340.0006 | 40.736 | 0.896620 | 480.1790 | 1.198 | 0.000193 | 480.2312 | 3.722 | -0.007845 |
| 341.0020 | 39.834 | 0.890744 | 482.1764 | 1.195 | 0.000149 | 482.2481 | 3.684 | -0.008739 |
| 342.0052 | 38.950 | 0.885115 | 484.1762 | 1.197 | 0.000179 | 484.2500 | 3.644 | 0.000386 |
| 343.0117 | 38.069 | 0.880766 | 486.1778 | 1.196 | 0.000174 | 486.2480 | 3.662 | 0.004481 |
| 344.0105 | 37.186 | 0.877179 | 488.1774 | 1.196 | 0.000155 | 488.2504 | 3.658 | -0.001952 |
| 345.0155 | 36.316 | 0.874538 | 490.1809 | 1.195 | 0.000173 | 490.2512 | 3.658 | -0.000877 |
| 346.0220 | 35.446 | 0.871606 | 492.1770 | 1.193 | 0.000368 | 492.2513 | 3.677 | -0.000316 |
| 347.0312 | 34.573 | 0.870139 | 494.1809 | 1.194 | 0.000386 | 494.2516 | 3.659 | 0.000272 |
| 348.0270 | 33.676 | 0.869651 | 496.1840 | 1.192 | 0.000484 | 496.2544 | 3.653 | -0.000423 |
| 349.0259 | 32.814 | 0.871120 | 498.1794 | 1.193 | 0.000423 | 498.2544 | 3.669 | -0.001662 |
| 350.0326 | 31.955 | 0.873321 | 500.1825 | 1.190 | 0.000315 | 500.2618 | 3.683 | -0.001975 |
| 351.0500 | 31.088 | 0.876389 | 502.1858 | 1.191 | 0.000270 | 502.2636 | 3.668 | -0.001512 |
| 352.0536 | 30.191 | 0.880193 | 504.1877 | 1.191 | 0.000240 | 504.2709 | 3.664 | 0.000076 |
| 353.0642 | 29.297 | 0.884788 | 506.1885 | 1.190 | 0.000579 | 506.2719 | 3.675 | 0.000395 |
| 354.0735 | 28.401 | 0.890041 | 508.1914 | 1.189 | 0.000316 | 508.2736 | 3.674 | -0.000066 |
| 355.0825 | 27.498 | 0.891486 | 510.1939 | 1.185 | 0.000304 | 510.2785 | 3.667 | 0.001048 |
| 356.0782 | 26.596 | 0.889039 | 512.1972 | 1.188 | 0.000023 | 512.2831 | 3.681 | 0.000934 |
| 357.0669 | 25.703 | 0.882858 | 514.2022 | 1.188 | 0.000155 | 514.2850 | 3.662 | 0.000176 |
| 358.0481 | 24.823 | 0.872990 | 516.2050 | 1.191 | 0.000366 | 516.2912 | 3.665 | -0.000498 |
| 359.0281 | 24.016 | 0.858835 | 518.2094 | 1.184 | 0.000238 | 518.2954 | 3.682 | -0.001279 |
| 360.0091 | 23.130 | 0.841440 | 520.2174 | 1.187 | 0.000334 | 520.2924 | 3.705 | 0.002366 |
| 360.9879 | 22.298 | 0.821813 | 522.2213 | 1.188 | -0.000908 | 522.2961 | 3.665 | -0.001862 |
| 361.9660 | 21.505 | 0.800095 | 524.2190 | 1.171 | -0.000694 | 524.2915 | 3.532 | -0.003199 |
| 362.9504 | 20.731 | 0.776689 | 526.2301 | 1.191 | -0.000784 | 526.3003 | 3.701 | -0.004791 |
| 363.9355 | 19.980 | 0.753223 | 528.2354 | 1.188 | 0.001044 | 528.3042 | 3.694 | -0.003876 |
| 364.9130 | 19.243 | 0.725992 | 530.2314 | 1.187 | -0.000836 | 530.3105 | 3.699 | 0.004238 |
| 365.9037 | 18.543 | 0.699660 | 532.2200 | 1.127 | -0.001841 | 532.3134 | 3.707 | 0.002296 |
| 366.8940 | 17.870 | 0.672955 | 534.2385 | 1.217 | -0.002153 | 534.3186 | 3.670 | 0.000741 |
| 367.8610 | 17.139 | 0.647817 | 536.2385 | 1.191 | -0.002070 | 536.3206 | 3.673 | -0.000997 |
| 368.8672 | 16.602 | 0.620694 | 538.2430 | 1.190 | 0.003567 | 538.3254 | 3.713 | -0.003300 |
| 369.8562 | 15.992 | 0.595190 | 540.2466 | 1.187 | 0.000036 | 540.3285 | 3.683 | -0.003678 |
| 370.8444 | 15.415 | 0.570630 | 542.2491 | 1.187 | 0.001091 | 542.3315 | 3.713 | -0.000937 |
| 371.8339 | 14.858 | 0.545773 | 544.2480 | 1.191 | -0.001218 | 544.3371 | 3.722 | -0.001094 |
| 372.8293 | 14.335 | 0.521425 | 546.2395 | 1.129 | -0.001391 | 546.3382 | 3.686 | -0.000807 |
| 373.8244 | 13.815 | 0.499378 | 548.2566 | 1.203 | -0.001235 | 548.3389 | 3.705 | -0.000880 |
| 374.8200 | 13.338 | 0.476292 | 550.2602 | 1.194 | -0.001438 | 550.3387 | 3.712 | -0.001609 |
| 375.8194 | 12.876 | 0.453717 | 552.2630 | 1.192 | 0.001804 | 552.3414 | 3.724 | -0.001473 |
| 376.8260 | 12.442 | 0.432177 | 554.2670 | 1.191 | -0.000447 | 554.3471 | 3.710 | -0.002207 |
| 377.8257 | 12.018 | 0.411268 | 556.2690 | 1.195 | -0.000546 | 556.3498 | 3.730 | -0.001357 |
| 378.8300 | 11.615 | 0.390547 | 558.2734 | 1.195 | -0.000205 | 558.3545 | 3.722 | -0.001876 |
| 379.8328 | 11.234 | 0.371227 | 560.2761 | 1.193 | -0.000234 | 560.3604 | 3.723 | -0.001517 |
| 380.8408 | 10.875 | 0.352530 | 562.2820 | 1.195 | 0.000024 | 562.3678 | 3.739 | -0.001965 |
| 381.8478 | 10.527 | 0.333926 | 564.2887 | 1.198 | 0.000222 | 564.3672 | 3.723 | -0.001511 |
| 382.8533 | 10.205 | 0.315759 | 566.2926 | 1.195 | 0.000191 | 566.3687 | 3.737 | 0.008718 |
| 383.8564 | 9.896 | 0.298514 | 568.2965 | 1.193 | 0.000384 | 568.3676 | 3.724 | -0.002324 |
| 384.8588 | 9.603 | 0.281316 | 570.3004 | 1.194 | 0.000034 | 570.3680 | 3.737 | 0.004470 |
| 385.8636 | 9.334 | 0.263724 | 572.3016 | 1.192 | -0.000058 | 572.3738 | 3.828 | -0.002889 |
| 386.8686 | 9.077 | 0.246401 | 574.3051 | 1.193 | 0.000843 | 574.3769 | 3.747 | -0.008156 |
| 387.8728 | 8.833 | 0.229527 | 576.3078 | 1.189 | -0.000272 | 576.3701 | 3.605 | 0.000385 |
| 388.8769 | 8.611 | 0.213158 | 578.3076 | 1.191 | -0.000561 | 578.3887 | 3.784 | -0.008143 |
| 389.8855 | 8.409 | 0.197034 | 580.3106 | 1.195 | 0.002513 | 580.3941 | 3.762 | -0.001532 |
| 390.8928 | 8.226 | 0.181383 | 582.3176 | 1.196 | -0.002161 | 582.4058 | 3.838 | 0.006139 |
| 391.9033 | 8.052 | 0.166243 | 584.3106 | 1.109 | -0.000826 | 584.4008 | 3.711 | 0.001676 |
| 392.9090 | 7.887 | 0.151232 | 586.3295 | 1.230 | -0.000922 | 586.4026 | 3.756 | 0.001045 |
| 393.9133 | 7.748 | 0.137569 | 588.3344 | 1.181 | -0.002002 | 588.4060 | 3.752 | -0.002289 |
| 394.9209 | 7.614 | 0.123695 | 590.3377 | 1.196 | 0.003202 | 590.4102 | 3.764 | -0.001150 |
| 395.9178 | 7.483 | 0.109527 | 592.3453 | 1.203 | -0.000488 | 592.4127 | 3.762 | 0.001875 |
| 396.9278 | 7.414 | 0.095921 | 594.3458 | 1.195 | 0.000011 | 594.4150 | 3.759 | 0.000323 |
| 397.9328 | 7.299 | 0.084461 | 596.3484 | 1.197 | 0.000502 | 596.4188 | 3.764 | -0.007174 |
| 398.9450 | 7.222 | 0.073303 | 598.3510 | 1.200 | -0.000299 | 598.4198 | 3.740 | -0.007713 |
| 399.9612 | 7.166 | 0.063969 | 600.3516 | 1.199 | -0.000215 | 600.4372 | 3.823 | -0.008325 |

Table B-2: Continued

| 4wt% silica in PMMA, 10C/min | | | Pure PMMA, 20C/min | | | 1wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 400.9846 | 7.119 | 0.055887 | 602.3550 | 1.200 | -0.000328 | 602.4441 | 3.780 | -0.006896 |
| 402.0122 | 7.057 | 0.049494 | 604.3589 | 1.198 | -0.000378 | 604.4425 | 3.787 | 0.005203 |
| 403.0324 | 7.020 | 0.043718 | 606.3681 | 1.200 | -0.000469 | 606.4432 | 3.782 | -0.001271 |
| 404.0510 | 6.971 | 0.039951 | 608.3682 | 1.200 | -0.000453 | 608.4490 | 3.793 | -0.000925 |
| 405.0614 | 6.926 | 0.035317 | 610.3747 | 1.204 | -0.000401 | 610.4609 | 3.800 | -0.001761 |
| 406.0710 | 6.901 | 0.031484 | 612.3787 | 1.201 | 0.002708 | 612.4660 | 3.789 | -0.003241 |
| 407.0775 | 6.873 | 0.027694 | 614.3873 | 1.202 | 0.000018 | 614.4746 | 3.803 | -0.000724 |
| 408.0858 | 6.841 | 0.024985 | 616.3904 | 1.204 | -0.002554 | 616.4824 | 3.839 | -0.001664 |
| 409.0902 | 6.862 | 0.022171 | 618.3852 | 1.186 | -0.002402 | 618.4813 | 3.787 | -0.001443 |
| 410.0981 | 6.806 | 0.021457 | 620.4060 | 1.220 | -0.001509 | 620.4812 | 3.805 | 0.001945 |
| 411.0990 | 6.782 | 0.018904 | 622.4108 | 1.203 | 0.000352 | 622.4839 | 3.828 | -0.005654 |
| 412.1014 | 6.768 | 0.018070 | 624.4091 | 1.205 | 0.002072 | 624.4709 | 3.553 | -0.002418 |
| 413.1000 | 6.750 | 0.016513 | 626.4093 | 1.204 | -0.000383 | 626.4842 | 3.845 | -0.000783 |
| 414.0956 | 6.728 | 0.016227 | 628.4107 | 1.207 | -0.000865 | 628.4895 | 3.823 | -0.004266 |
| 415.0894 | 6.752 | 0.014532 | 630.4119 | 1.203 | -0.000034 | 630.4918 | 3.823 | 0.003242 |
| 416.0894 | 6.697 | 0.013738 | 632.4140 | 1.209 | 0.000528 | 632.4951 | 3.826 | -0.001160 |
| 417.0854 | 6.686 | 0.014164 | 634.4182 | 1.207 | 0.000162 | 634.4995 | 3.823 | -0.001864 |
| 418.0870 | 6.687 | 0.011421 | 636.4201 | 1.205 | 0.000388 | 636.5037 | 3.830 | -0.001622 |
| 419.0839 | 6.665 | 0.010366 | 638.4244 | 1.205 | -0.000372 | 638.5089 | 3.829 | 0.002109 |
| 420.0788 | 6.655 | 0.011241 | 640.4215 | 1.203 | -0.000558 | 640.5139 | 3.837 | 0.000293 |
| 421.0719 | 6.646 | 0.008769 | 642.4217 | 1.210 | -0.000896 | 642.5002 | 3.566 | -0.007288 |
| 422.0559 | 6.567 | 0.008599 | 644.4248 | 1.210 | -0.000764 | 644.5127 | 3.615 | -0.008226 |
| 423.0736 | 6.640 | 0.007919 | 646.4297 | 1.213 | -0.000867 | 646.5297 | 3.894 | -0.008289 |
| 424.0758 | 6.651 | 0.006848 | 648.4372 | 1.211 | -0.000984 | 648.5352 | 3.850 | 0.000352 |
| 425.0740 | 6.614 | 0.006519 | 650.4443 | 1.218 | -0.000551 | 650.5368 | 3.841 | 0.007133 |
| 426.0735 | 6.616 | 0.006404 | 652.4512 | 1.219 | -0.000635 | 652.5342 | 3.874 | -0.000583 |
| 427.0697 | 6.597 | 0.008303 | 654.4506 | 1.215 | -0.000184 | 654.5362 | 3.848 | -0.000493 |
| 428.0691 | 6.598 | 0.006830 | 656.4550 | 1.215 | 0.000061 | 656.5374 | 3.860 | 0.010815 |
| 429.0667 | 6.595 | 0.006901 | 658.4549 | 1.215 | -0.000184 | 658.5395 | 3.865 | -0.007177 |
| 430.0666 | 6.582 | 0.005870 | 660.4588 | 1.216 | -0.000167 | 660.5328 | 3.509 | -0.008567 |
| 431.0593 | 6.577 | 0.005670 | 662.4649 | 1.223 | 0.001277 | 662.5460 | 4.026 | -0.010853 |
| 432.0540 | 6.612 | 0.005411 | 664.4640 | 1.214 | 0.000073 | 664.5478 | 3.881 | -0.003314 |
| 433.0550 | 6.568 | 0.005152 | 666.4666 | 1.225 | -0.002045 | 666.5496 | 3.919 | 0.013828 |
| 434.0552 | 6.565 | 0.004452 | 668.4556 | 1.176 | -0.002006 | 668.5499 | 3.867 | -0.001372 |
| 435.0553 | 6.560 | 0.003906 | 670.4775 | 1.235 | -0.001798 | 670.5532 | 4.017 | -0.003584 |
| 436.0508 | 6.542 | 0.003936 | 672.4802 | 1.223 | -0.002089 | 672.5682 | 3.893 | -0.007113 |
| 437.0474 | 6.549 | 0.005896 | 674.4798 | 1.221 | 0.002527 | 674.5699 | 3.885 | -0.004826 |
| 438.0513 | 6.544 | 0.005399 | 676.4808 | 1.225 | -0.000122 | 676.5724 | 3.885 | 0.009691 |
| 439.0520 | 6.544 | 0.004244 | 678.4861 | 1.219 | -0.000419 | 678.5728 | 3.893 | -0.002927 |
| 440.0522 | 6.536 | 0.003835 | 680.4906 | 1.228 | 0.003477 | 680.5762 | 3.889 | -0.004142 |
| 441.0458 | 6.522 | 0.003622 | 682.4950 | 1.225 | 0.003336 | 682.5868 | 3.967 | -0.006543 |
| 442.0465 | 6.523 | 0.003844 | 684.4965 | 1.227 | -0.003322 | 684.5868 | 3.989 | -0.006897 |
| 443.0520 | 6.565 | 0.003413 | 686.4858 | 1.197 | -0.004065 | 686.5991 | 3.908 | 0.003448 |
| 444.0558 | 6.523 | 0.003354 | 688.5036 | 1.322 | -0.004225 | 688.6000 | 3.916 | -0.003025 |
| 445.0547 | 6.516 | 0.002747 | 690.5142 | 1.232 | -0.001893 | 690.6030 | 3.913 | 0.002960 |
| 446.0522 | 6.512 | 0.002460 | 692.5150 | 1.225 | 0.006981 | 692.6001 | 3.913 | 0.000451 |
| 447.0514 | 6.514 | 0.002315 | 694.5163 | 1.230 | 0.000264 | 694.6015 | 3.902 | 0.000172 |
| 448.0507 | 6.508 | 0.003970 | 696.5158 | 1.189 | -0.000862 | 696.5991 | 3.905 | 0.000128 |
| 449.0447 | 6.495 | 0.001751 | 698.5222 | 1.247 | -0.001083 | 698.6056 | 3.918 | -0.001095 |
| 450.0490 | 6.512 | 0.002103 | 700.5224 | 1.227 | -0.000957 | 700.6105 | 3.909 | 0.006211 |
| 451.0536 | 6.513 | 0.002457 | 702.5232 | 1.230 | 0.002469 | 702.6166 | 3.918 | -0.004843 |
| 452.0583 | 6.506 | 0.003074 | 704.5164 | 1.133 | -0.000478 | 704.6118 | 3.792 | -0.005050 |
| 453.0542 | 6.551 | 0.002526 | 706.5328 | 1.231 | -0.000593 | 706.6199 | 3.979 | -0.003664 |
| 454.0570 | 6.492 | 0.002781 | 708.5398 | 1.230 | -0.000928 | 708.6216 | 3.917 | -0.003283 |
| 455.0548 | 6.479 | 0.003320 | 710.5394 | 1.231 | 0.000010 | 710.6272 | 3.921 | 0.010193 |
| 456.0554 | 6.483 | 0.002811 | 712.5464 | 1.229 | -0.000338 | 712.6300 | 3.931 | 0.000581 |
| 457.0552 | 6.535 | 0.001629 | 714.5480 | 1.237 | 0.000209 | 714.6329 | 3.932 | 0.000085 |
| 458.0524 | 6.487 | 0.002906 | 716.5500 | 1.227 | 0.000273 | 716.6359 | 3.914 | 0.001152 |
| 459.0583 | 6.477 | 0.001780 | 718.5513 | 1.233 | 0.000337 | 718.6380 | 3.914 | 0.001496 |
| 460.0616 | 6.538 | 0.001318 | 720.5572 | 1.227 | 0.002260 | 720.6406 | 3.915 | 0.001087 |
| 461.0594 | 6.479 | 0.001216 | 722.5612 | 1.229 | -0.000826 | 722.6440 | 3.894 | -0.001693 |
| 462.0645 | 6.488 | 0.002805 | 724.5650 | 1.225 | -0.000845 | 724.6439 | 3.904 | -0.004142 |
| 463.0570 | 6.462 | 0.001466 | 726.5710 | 1.244 | -0.000907 | 726.6505 | 3.955 | -0.004238 |
| 464.0544 | 6.469 | 0.001086 | 728.5731 | 1.235 | 0.000952 | 728.6528 | 3.910 | -0.001862 |
| 465.0574 | 6.477 | 0.002882 | 730.5740 | 1.228 | 0.001387 | 730.6587 | 3.928 | 0.001612 |
| 466.0590 | 6.470 | 0.002350 | 732.5744 | 1.115 | -0.001279 | 732.6644 | 3.945 | 0.003769 |
| 467.0583 | 6.462 | 0.001365 | 734.5920 | 1.243 | -0.001569 | 734.6680 | 3.924 | 0.004036 |

Table B-2: Continued

| 4wt% silica in PMMA, 10C/min | | | Pure PMMA, 20C/min | | | 1wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 468.0634 | 6.468 | 0.002833 | 736.5922 | 1.237 | -0.001086 | 736.6725 | 3.894 | 0.004218 |
| 469.0666 | 6.465 | 0.003373 | 738.5942 | 1.235 | 0.002935 | 738.6770 | 3.934 | -0.001520 |
| 470.0627 | 6.440 | 0.001246 | 740.5930 | 1.226 | -0.000142 | 740.6784 | 3.885 | 0.003818 |
| 471.0600 | 6.459 | 0.000964 | 742.5985 | 1.235 | -0.000537 | 742.6734 | 3.841 | -0.008889 |
| 472.0687 | 6.461 | 0.001505 | 744.5980 | 1.240 | -0.000360 | 744.6838 | 3.977 | -0.010925 |
| 473.0578 | 6.384 | 0.001271 | 746.6011 | 1.234 | 0.000354 | 746.6878 | 4.062 | -0.005747 |
| 474.0717 | 6.541 | 0.000848 | 748.6008 | 1.232 | 0.000300 | 748.6929 | 3.944 | 0.000201 |
| 475.0747 | 6.458 | 0.001190 | 750.6018 | 1.234 | -0.000122 | 750.6968 | 3.921 | 0.004131 |
| 476.0740 | 6.452 | 0.001976 | 752.6075 | 1.238 | -0.001047 | 752.6978 | 3.942 | 0.000275 |
| 477.0732 | 6.447 | 0.001689 | 754.6100 | 1.281 | -0.000936 | 754.7012 | 3.956 | -0.001908 |
| 478.0709 | 6.447 | 0.002242 | 756.6219 | 1.238 | -0.000825 | 756.7022 | 3.974 | -0.001163 |
| 479.0709 | 6.450 | 0.004154 | 758.6272 | 1.233 | -0.002169 | 758.7060 | 3.924 | 0.000989 |
| 480.0664 | 6.438 | 0.001806 | 760.6305 | 1.235 | 0.005926 | 760.7097 | 3.969 | 0.003062 |
| 481.0620 | 6.432 | 0.001661 | 762.6337 | 1.238 | -0.001319 | 762.7138 | 3.929 | 0.005249 |
| 482.0687 | 6.472 | 0.003786 | 764.6308 | 1.222 | -0.001058 | 764.7125 | 3.953 | 0.006605 |
| 483.0704 | 6.440 | 0.002894 | 766.6357 | 1.335 | -0.001980 | 766.7107 | 3.901 | 0.003138 |
| 484.0696 | 6.429 | 0.000962 | 768.6437 | 1.225 | -0.003207 | 768.7189 | 3.922 | 0.016500 |
| 485.0696 | 6.434 | 0.001466 | 770.6452 | 1.241 | 0.002498 | 770.7207 | 3.918 | -0.007379 |
| 486.0715 | 6.428 | 0.000913 | 772.6454 | 1.241 | 0.004390 | 772.7180 | 3.583 | -0.006746 |
| 487.0563 | 6.359 | 0.002129 | 774.6465 | 1.232 | -0.000550 | 774.7356 | 4.113 | -0.006839 |
| 488.0670 | 6.435 | 0.001651 | 776.6397 | 1.160 | -0.001134 | 776.7447 | 3.921 | -0.006240 |
| 489.0844 | 6.422 | 0.001262 | 778.6558 | 1.273 | -0.001450 | 778.7361 | 3.901 | 0.014469 |
| 490.0834 | 6.453 | 0.001483 | 780.6582 | 1.242 | -0.000932 | 780.7343 | 3.933 | 0.003126 |
| 491.0848 | 6.424 | 0.001238 | 782.6621 | 1.234 | 0.004192 | 782.7324 | 3.901 | 0.000915 |
| 492.0830 | 6.410 | 0.002823 | 784.6616 | 1.237 | 0.000930 | 784.7361 | 3.907 | 0.002149 |
| 493.0836 | 6.413 | 0.003497 | 786.6636 | 1.240 | -0.001161 | 786.7460 | 3.919 | -0.000596 |
| 494.0824 | 6.418 | 0.003333 | 788.6650 | 1.228 | -0.000013 | 788.7499 | 3.914 | -0.000535 |
| 495.0818 | 6.412 | 0.002662 | 790.6747 | 1.254 | -0.002444 | 790.7551 | 3.912 | 0.001565 |
| 496.0824 | 6.412 | 0.001439 | 792.6730 | 1.160 | -0.002466 | 792.7611 | 3.911 | -0.003706 |
| 497.0820 | 6.411 | 0.001070 | 794.6882 | 1.259 | 0.001084 | 794.7595 | 3.753 | -0.005039 |
| 498.0701 | 6.332 | 0.001102 | 796.6876 | 1.242 | -0.002389 | 796.7754 | 3.936 | -0.003905 |
| 499.0706 | 6.380 | 0.001653 | 798.6806 | 1.121 | 0.002371 | 798.7769 | 3.933 | -0.004646 |
| 500.0824 | 6.404 | 0.001922 | 800.6934 | 1.256 | -0.000688 | 800.7782 | 3.914 | 0.005382 |
| 501.0836 | 6.409 | 0.001669 | 802.6978 | 1.244 | -0.000882 | 802.7735 | 3.924 | 0.000557 |
| 502.0846 | 6.405 | 0.001522 | 804.6962 | 1.237 | 0.003132 | 804.7718 | 3.907 | 0.000221 |
| 503.0868 | 6.399 | 0.000739 | 806.7000 | 1.240 | -0.000069 | 806.7788 | 3.934 | 0.000090 |
| 504.0796 | 6.385 | 0.003545 | 808.7075 | 1.243 | -0.001478 | 808.7780 | 3.904 | -0.000274 |
| 505.0804 | 6.390 | 0.002255 | 810.7082 | 1.242 | -0.000628 | 810.7811 | 3.909 | -0.003144 |
| 506.0858 | 6.392 | 0.000923 | 812.7166 | 1.241 | -0.000070 | 812.7918 | 3.902 | -0.001284 |
| 507.0874 | 6.391 | 0.000454 | 814.7188 | 1.232 | 0.000419 | 814.7896 | 4.084 | -0.001225 |
| 508.0886 | 6.385 | -0.000089 | 816.7153 | 1.243 | 0.000601 | 816.7918 | 3.883 | 0.000268 |
| 509.0910 | 6.439 | 0.001777 | 818.7168 | 1.244 | 0.000532 | 818.7944 | 3.917 | 0.002259 |
| 510.0920 | 6.441 | 0.001419 | 820.7156 | 1.242 | 0.000268 | 820.8030 | 3.879 | 0.001574 |
| 511.0949 | 6.390 | 0.002807 | 822.7187 | 1.248 | 0.000395 | 822.8062 | 3.865 | 0.001929 |
| 512.0928 | 6.388 | 0.001822 | 824.7175 | 1.243 | 0.000134 | 824.8108 | 3.899 | 0.000615 |
| 513.0922 | 6.380 | 0.002595 | 826.7215 | 1.244 | -0.000114 | 826.8093 | 3.928 | -0.001195 |
| 514.0852 | 6.413 | 0.003156 | 828.7241 | 1.245 | -0.000934 | 828.8142 | 3.919 | -0.000552 |
| 515.0906 | 6.382 | 0.001810 | 830.7255 | 1.247 | -0.000166 | 830.8134 | 3.899 | -0.001101 |
| 516.0850 | 6.315 | 0.000021 | 832.7274 | 1.245 | -0.000235 | 832.8180 | 3.904 | 0.001395 |
| 517.0896 | 6.304 | -0.001262 | 834.7375 | 1.245 | -0.001219 | 834.8203 | 3.911 | -0.003422 |
| 518.0930 | 6.321 | -0.002029 | 836.7438 | 1.240 | 0.000030 | 836.8324 | 3.851 | -0.003634 |
| 519.1042 | 6.422 | 0.000068 | 838.7538 | 1.270 | 0.000453 | 838.8301 | 3.915 | 0.003349 |
| 520.1082 | 6.373 | 0.000143 | 840.7534 | 1.232 | -0.000384 | 840.8316 | 3.900 | -0.004837 |
| 521.1076 | 6.383 | 0.001668 | 842.7524 | 1.243 | 0.000529 | 842.8360 | 3.880 | -0.004136 |
| 522.1086 | 6.385 | 0.000725 | 844.7536 | 1.276 | -0.000678 | 844.8368 | 4.137 | -0.006515 |
| 523.1041 | 6.376 | 0.002790 | 846.7578 | 1.238 | 0.000511 | 846.8426 | 3.959 | -0.007744 |
| 524.0982 | 6.369 | 0.004353 | 848.7582 | 1.245 | 0.001129 | 848.8390 | 3.946 | -0.003090 |
| 525.0926 | 6.359 | 0.002349 | 850.7563 | 1.246 | -0.000506 | 850.8349 | 3.979 | 0.006370 |
| 526.0948 | 6.367 | 0.002091 | 852.7564 | 1.245 | 0.000308 | 852.8348 | 3.910 | 0.005764 |
| 527.0980 | 6.371 | 0.001116 | 854.7570 | 1.244 | 0.000358 | 854.8388 | 3.877 | 0.008308 |
| 528.0996 | 6.361 | -0.000078 | 856.7559 | 1.238 | 0.000004 | 856.8437 | 3.887 | 0.021755 |
| 529.0970 | 6.323 | -0.000642 | 858.7664 | 1.246 | 0.000190 | 858.8509 | 3.879 | -0.004210 |
| 530.1048 | 6.383 | -0.000408 | 860.7688 | 1.246 | 0.000319 | 860.8526 | 3.735 | -0.007075 |
| 531.1110 | 6.379 | -0.000247 | 862.7743 | 1.244 | 0.000648 | 862.8592 | 4.178 | -0.010694 |
| 532.1105 | 6.360 | -0.000589 | 864.7734 | 1.236 | 0.000738 | 864.8601 | 3.909 | -0.007976 |
| 533.1103 | 6.363 | -0.000431 | 866.7848 | 1.239 | 0.000315 | 866.8653 | 3.901 | 0.011962 |
| 534.1091 | 6.367 | 0.000226 | 868.7863 | 1.240 | -0.000604 | 868.8606 | 3.900 | 0.004355 |

Table B-2: Continued

| 4wt% silica in PMMA, 10C/min | | | Pure PMMA, 20C/min | | | 1wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 535.1045 | 6.366 | 0.001121 | 870.7928 | 1.241 | -0.000348 | 870.8632 | 3.891 | 0.005165 |
| 536.1060 | 6.366 | 0.000456 | 872.8004 | 1.247 | -0.000270 | 872.8678 | 3.910 | 0.000399 |
| 537.1067 | 6.368 | 0.002960 | 874.7994 | 1.242 | 0.000194 | 874.8778 | 3.858 | -0.000313 |
| 538.1085 | 6.359 | 0.000198 | 876.8024 | 1.236 | 0.000085 | 876.8711 | 3.907 | -0.001745 |
| 539.1084 | 6.359 | -0.000470 | 878.8019 | 1.239 | -0.000204 | 878.8812 | 3.951 | -0.000882 |
| 540.1102 | 6.374 | -0.000774 | 880.8056 | 1.251 | -0.000150 | 880.8816 | 3.904 | 0.002589 |
| 541.1124 | 6.366 | -0.000885 | 882.8069 | 1.241 | 0.003796 | 882.8844 | 3.848 | 0.000856 |
| 542.0974 | 6.303 | 0.001129 | 884.8087 | 1.240 | -0.001168 | 884.8872 | 3.938 | 0.000112 |
| 543.1210 | 6.384 | -0.000464 | 886.8072 | 1.226 | -0.002565 | 886.8918 | 3.928 | -0.002065 |
| 544.1252 | 6.369 | -0.000295 | 888.8188 | 1.275 | -0.002723 | 888.8941 | 3.869 | 0.000175 |
| 545.1210 | 6.366 | 0.000194 | 890.8195 | 1.252 | -0.002288 | 890.8960 | 3.913 | -0.001403 |
| 546.1201 | 6.363 | 0.002070 | 892.8202 | 1.241 | 0.004918 | 892.8962 | 3.905 | -0.000002 |
| 547.1099 | 6.335 | 0.002594 | 894.8202 | 1.241 | 0.001808 | 894.9015 | 3.945 | 0.001587 |
| 548.1191 | 6.367 | 0.001543 | 896.8228 | 1.242 | 0.001005 | 896.9009 | 3.877 | -0.003818 |
| 549.1172 | 6.364 | 0.001080 | 898.8259 | 1.239 | 0.000321 | 898.8961 | 3.861 | 0.002693 |
| 550.1230 | 6.358 | 0.000693 | 900.8254 | 1.244 | 0.000122 | 900.9081 | 3.958 | 0.000256 |
| 551.1068 | 6.308 | 0.000307 | 902.8296 | 1.241 | 0.000036 | 902.9046 | 3.847 | 0.004031 |
| 552.1230 | 6.366 | 0.002294 | 904.8300 | 1.231 | 0.002444 | 904.9108 | 3.868 | 0.002710 |
| 553.1201 | 6.353 | 0.000638 | 906.8339 | 1.230 | 0.000063 | 906.9118 | 3.862 | 0.000843 |
| 554.1203 | 6.351 | -0.000168 | 908.8339 | 1.238 | -0.000596 | 908.9174 | 3.912 | -0.001465 |
| 555.1230 | 6.356 | -0.000886 | 910.8376 | 1.307 | -0.000978 | 910.9100 | 3.603 | -0.002686 |
| 556.1221 | 6.350 | 0.000877 | 912.8384 | 1.233 | -0.000685 | 912.9151 | 3.877 | -0.007166 |
| 557.1255 | 6.354 | 0.000114 | 914.8464 | 1.263 | -0.001365 | 914.9197 | 3.913 | -0.008370 |
| 558.1299 | 6.365 | 0.000428 | 916.8501 | 1.238 | 0.000849 | 916.9186 | 3.927 | 0.002889 |
| 559.1304 | 6.360 | 0.000421 | 918.8481 | 1.250 | 0.001757 | 918.9204 | 3.912 | 0.004010 |
| 560.1326 | 6.360 | 0.000730 | 920.8494 | 1.230 | 0.000965 | 920.9246 | 3.877 | 0.003401 |
| 561.1318 | 6.350 | 0.000457 | 922.8504 | 1.220 | 0.000949 | 922.9301 | 3.892 | 0.002735 |
| 562.1279 | 6.341 | 0.000562 | 924.8524 | 1.228 | -0.001026 | 924.9278 | 3.919 | 0.004461 |
| 563.1258 | 6.349 | 0.000399 | 926.8547 | 1.225 | -0.001709 | 926.9309 | 3.882 | 0.003146 |
| 564.1320 | 6.356 | 0.000053 | 928.8524 | 1.234 | 0.000246 | 928.9386 | 3.817 | 0.000230 |
| 565.1283 | 6.351 | -0.000332 | 930.8579 | 1.232 | -0.001147 | 930.9340 | 3.831 | -0.003239 |
| 566.1346 | 6.351 | -0.000329 | 932.8578 | 1.119 | -0.000056 | 932.9366 | 3.902 | -0.006120 |
| 567.1374 | 6.359 | -0.000008 | 934.8641 | 1.246 | -0.000542 | 934.9388 | 3.899 | 0.006621 |
| 568.1375 | 6.358 | 0.000448 | 936.8648 | 1.231 | -0.001629 | 936.9376 | 3.919 | -0.000087 |
| 569.1374 | 6.354 | 0.000232 | 938.8636 | 1.233 | 0.002080 | 938.9356 | 3.511 | -0.002565 |
| 570.1398 | 6.351 | -0.000015 | 940.8700 | 1.237 | -0.001393 | 940.9472 | 3.940 | -0.010959 |
| 571.1416 | 6.348 | 0.001582 | | | | | | |
| 572.1430 | 6.352 | -0.000357 | | | | | | |
| 573.1474 | 6.357 | -0.000333 | | | | | | |
| 574.1513 | 6.358 | -0.000486 | | | | | | |
| 575.1474 | 6.361 | -0.000405 | | | | | | |
| 576.1342 | 6.322 | 0.000217 | | | | | | |
| 577.1434 | 6.358 | 0.000651 | | | | | | |
| 578.1453 | 6.348 | 0.001075 | | | | | | |
| 579.1460 | 6.355 | 0.001146 | | | | | | |
| 580.1438 | 6.347 | 0.000543 | | | | | | |
| 581.1436 | 6.348 | 0.002093 | | | | | | |
| 582.1418 | 6.348 | 0.000937 | | | | | | |
| 583.1440 | 6.341 | 0.000212 | | | | | | |
| 584.1454 | 6.349 | -0.000264 | | | | | | |
| 585.1472 | 6.347 | -0.000314 | | | | | | |
| 586.1486 | 6.343 | -0.000007 | | | | | | |
| 587.1462 | 6.344 | -0.000708 | | | | | | |
| 588.1500 | 6.362 | 0.000035 | | | | | | |
| 589.1488 | 6.353 | 0.000749 | | | | | | |
| 590.1477 | 6.334 | 0.001260 | | | | | | |
| 591.1508 | 6.351 | 0.000129 | | | | | | |
| 592.1538 | 6.343 | 0.000133 | | | | | | |
| 593.1528 | 6.337 | -0.000279 | | | | | | |
| 594.1532 | 6.337 | 0.000532 | | | | | | |
| 595.1486 | 6.260 | 0.000418 | | | | | | |
| 596.1640 | 6.355 | -0.000668 | | | | | | |
| 597.1660 | 6.352 | -0.001463 | | | | | | |
| 598.1640 | 6.355 | -0.000668 | | | | | | |
| 599.1516 | 6.244 | -0.000547 | | | | | | |
| 600.1638 | 6.417 | 0.000565 | | | | | | |
| 601.1678 | 6.354 | 0.000472 | | | | | | |

Table B-2: Continued
4wt% silica in PMMA, 10C/min

| Temperature (°C) | mass (%) | mass loss rate (%/°C) |
|---|---|---|
| 602.1691 | 6.332 | 0.000170 |
| 603.1697 | 6.345 | 0.000134 |
| 604.1678 | 6.347 | 0.000144 |
| 605.1670 | 6.339 | 0.002480 |
| 606.1650 | 6.340 | 0.001163 |
| 607.1679 | 6.348 | 0.000517 |
| 608.1709 | 6.350 | -0.000202 |
| 609.1722 | 6.341 | -0.000927 |
| 610.1713 | 6.327 | -0.000875 |
| 611.1684 | 6.341 | -0.000591 |
| 612.1782 | 6.364 | -0.000679 |
| 613.1840 | 6.353 | 0.001152 |
| 614.1836 | 6.347 | -0.000470 |
| 615.1795 | 6.311 | -0.000383 |
| 616.1865 | 6.382 | 0.000622 |
| 617.1812 | 6.335 | 0.001065 |
| 618.1701 | 6.362 | 0.000487 |
| 619.1772 | 6.349 | 0.000181 |
| 620.1792 | 6.349 | -0.001044 |
| 621.1800 | 6.336 | 0.001337 |
| 622.1804 | 6.340 | -0.001045 |
| 623.1791 | 6.338 | 0.000281 |
| 624.1800 | 6.347 | -0.000716 |
| 625.1840 | 6.363 | -0.000434 |
| 626.1729 | 6.258 | -0.000055 |
| 627.1863 | 6.383 | 0.000067 |
| 628.1868 | 6.347 | -0.000297 |
| 629.1846 | 6.334 | -0.000095 |
| 630.1819 | 6.333 | 0.001111 |
| 631.1807 | 6.339 | 0.000383 |
| 632.1830 | 6.355 | 0.000946 |
| 633.1856 | 6.355 | 0.000547 |
| 634.1885 | 6.346 | 0.000463 |
| 635.1832 | 6.296 | 0.000405 |
| 636.1897 | 6.342 | 0.000601 |
| 637.1904 | 6.335 | 0.000940 |
| 638.1889 | 6.325 | -0.000085 |
| 639.1988 | 6.358 | -0.001198 |
| 640.2006 | 6.348 | -0.000552 |
| 641.2008 | 6.340 | -0.001659 |
| 642.1989 | 6.339 | -0.001271 |
| 643.2028 | 6.346 | -0.000524 |
| 644.2026 | 6.361 | 0.001838 |
| 645.2045 | 6.343 | 0.000488 |
| 646.2020 | 6.349 | 0.000198 |
| 647.1982 | 6.341 | 0.000857 |
| 648.2034 | 6.350 | 0.000763 |
| 649.1952 | 6.286 | 0.000093 |
| 650.2036 | 6.337 | -0.000206 |
| 651.2076 | 6.337 | -0.000299 |
| 652.2064 | 6.341 | 0.000456 |
| 653.2100 | 6.347 | 0.001748 |
| 654.2060 | 6.349 | 0.000783 |
| 655.2088 | 6.339 | -0.000251 |
| 656.2072 | 6.343 | -0.000334 |
| 657.2011 | 6.252 | -0.000111 |
| 658.2044 | 6.303 | -0.000515 |
| 659.2170 | 6.352 | 0.000196 |
| 660.2205 | 6.349 | -0.001458 |
| 661.2172 | 6.350 | -0.001732 |
| 662.2141 | 6.335 | -0.001758 |
| 663.2100 | 6.312 | 0.000875 |
| 664.2025 | 6.246 | -0.000067 |
| 665.2174 | 6.369 | 0.000167 |
| 666.2172 | 6.347 | 0.000529 |
| 667.2143 | 6.342 | -0.000065 |
| 668.2162 | 6.355 | -0.000364 |

Table B-2: Continued
4wt% silica in PMMA, 10C/min

| Temperature (°C) | mass (%) | mass loss rate (%/°C) |
|---|---|---|
| 672.2190 | 6.352 | -0.000077 |
| 673.2188 | 6.342 | -0.000312 |
| 674.2241 | 6.344 | -0.000367 |
| 675.2216 | 6.340 | 0.000210 |
| 676.2201 | 6.344 | 0.000694 |
| 677.2222 | 6.345 | 0.001209 |
| 678.2244 | 6.340 | 0.000131 |
| 679.2265 | 6.347 | -0.000727 |
| 680.2266 | 6.343 | -0.000782 |
| 681.2330 | 6.340 | -0.000170 |
| 682.2360 | 6.383 | -0.000022 |
| 683.2374 | 6.351 | 0.000495 |
| 684.2438 | 6.353 | 0.000462 |
| 685.2391 | 6.343 | -0.000291 |
| 686.2369 | 6.340 | -0.000390 |
| 687.2314 | 6.332 | 0.001003 |
| 688.2326 | 6.341 | 0.001943 |
| 689.2368 | 6.386 | -0.000498 |
| 690.2363 | 6.344 | -0.000863 |
| 691.2466 | 6.343 | 0.000187 |
| 692.2468 | 6.343 | -0.001131 |
| 693.2430 | 6.397 | 0.001667 |
| 694.2468 | 6.344 | 0.000318 |
| 695.2425 | 6.337 | -0.000716 |
| 696.2422 | 6.401 | -0.001182 |
| 697.2505 | 6.342 | -0.001639 |
| 698.2376 | 6.274 | 0.001185 |
| 699.2526 | 6.358 | -0.000769 |
| 700.2505 | 6.344 | -0.000827 |
| 701.2442 | 6.347 | 0.001489 |
| 702.2472 | 6.342 | -0.000201 |
| 703.2449 | 6.340 | 0.001649 |
| 704.2422 | 6.346 | 0.000696 |
| 705.2428 | 6.343 | 0.000509 |
| 706.2410 | 6.343 | 0.000396 |
| 707.2442 | 6.340 | -0.000006 |
| 708.2428 | 6.343 | 0.000133 |
| 709.2504 | 6.345 | 0.000602 |
| 710.2485 | 6.338 | 0.001850 |
| 711.2605 | 6.343 | -0.000053 |
| 712.2644 | 6.342 | -0.000166 |
| 713.2631 | 6.338 | -0.000088 |
| 714.2616 | 6.332 | -0.000033 |
| 715.2582 | 6.297 | 0.000044 |
| 716.2686 | 6.352 | 0.000212 |
| 717.2669 | 6.340 | 0.000214 |
| 718.2634 | 6.341 | 0.000291 |
| 719.2669 | 6.334 | 0.000022 |
| 720.2676 | 6.335 | 0.001119 |
| 721.2644 | 6.335 | -0.000088 |
| 722.2659 | 6.324 | 0.000549 |
| 723.2680 | 6.350 | -0.000960 |
| 724.2694 | 6.342 | -0.000643 |
| 725.2688 | 6.344 | 0.000964 |
| 726.2657 | 6.338 | -0.001195 |
| 727.2632 | 6.399 | -0.000903 |
| 728.2700 | 6.351 | 0.000505 |
| 729.2735 | 6.374 | 0.000475 |
| 730.2636 | 6.278 | 0.000726 |
| 731.2730 | 6.353 | 0.001302 |
| 732.2724 | 6.335 | 0.001738 |
| 733.2753 | 6.324 | -0.000466 |
| 734.2778 | 6.338 | -0.000060 |
| 735.2714 | 6.263 | 0.000595 |
| 736.2762 | 6.388 | -0.000836 |

Table B-3: TGA and DTG for 2wt%, and 4wt% silica in PMMA at 20C/min

| 2wt% silica in PMMA, 20C/min | | | 4wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 200.0975 | 100.000 | 0.015327 | 200.1575 | 100.000 | 0.015454 |
| 202.0978 | 99.967 | 0.014275 | 202.1587 | 100.013 | 0.015133 |
| 204.0965 | 99.943 | 0.011907 | 204.1526 | 99.955 | 0.018670 |
| 206.0924 | 99.920 | 0.010826 | 206.1479 | 99.931 | 0.013046 |
| 208.0938 | 99.899 | 0.010260 | 208.1356 | 99.794 | 0.009522 |
| 210.0898 | 99.881 | 0.010710 | 210.1438 | 99.918 | 0.012697 |
| 212.0858 | 99.862 | 0.010924 | 212.1418 | 99.880 | 0.008664 |
| 214.0834 | 99.840 | 0.012049 | 214.1302 | 99.722 | 0.014545 |
| 216.0848 | 99.816 | 0.008665 | 216.1423 | 99.819 | 0.008607 |
| 218.0695 | 99.707 | 0.008115 | 218.1292 | 99.752 | 0.001961 |
| 220.0778 | 99.809 | 0.009459 | 220.1341 | 99.780 | 0.010037 |
| 222.0775 | 99.769 | 0.009831 | 222.1383 | 99.803 | 0.009403 |
| 224.0645 | 99.586 | 0.013898 | 224.1349 | 99.725 | 0.010463 |
| 226.0706 | 99.715 | 0.008312 | 226.1200 | 99.605 | 0.011106 |
| 228.0770 | 99.705 | 0.005593 | 228.1342 | 99.726 | 0.015457 |
| 230.0732 | 99.676 | 0.009833 | 230.1286 | 99.637 | 0.009842 |
| 232.0766 | 99.678 | 0.008141 | 232.1300 | 99.687 | 0.012095 |
| 234.0771 | 99.649 | 0.009438 | 234.1262 | 99.733 | 0.005360 |
| 236.0738 | 99.634 | 0.011131 | 236.1284 | 99.719 | 0.005513 |
| 238.0724 | 99.620 | 0.011593 | 238.1303 | 99.625 | 0.010214 |
| 240.0678 | 99.592 | 0.011805 | 240.1283 | 99.595 | 0.013434 |
| 242.0674 | 99.561 | 0.013358 | 242.1264 | 99.584 | 0.015212 |
| 244.0650 | 99.537 | 0.019585 | 244.1224 | 99.534 | 0.013249 |
| 246.0662 | 99.509 | 0.014852 | 246.1174 | 99.513 | 0.013660 |
| 248.0518 | 99.370 | 0.017536 | 248.1142 | 99.471 | 0.015642 |
| 250.0657 | 99.504 | 0.020934 | 250.1140 | 99.440 | 0.021477 |
| 252.0680 | 99.373 | 0.025625 | 252.1179 | 99.378 | 0.022475 |
| 254.0665 | 99.325 | 0.040165 | 254.1170 | 99.328 | 0.022298 |
| 256.0710 | 99.243 | 0.041599 | 256.1176 | 99.319 | 0.027133 |
| 258.0707 | 99.155 | 0.049274 | 258.1180 | 99.258 | 0.028919 |
| 260.0734 | 99.049 | 0.060435 | 260.1204 | 99.126 | 0.038623 |
| 262.0767 | 98.927 | 0.074834 | 262.1170 | 99.118 | 0.047372 |
| 264.0817 | 98.759 | 0.092518 | 264.1158 | 99.000 | 0.053564 |
| 266.0872 | 98.555 | 0.113320 | 266.1197 | 98.858 | 0.065988 |
| 268.0992 | 98.313 | 0.138998 | 268.1198 | 98.724 | 0.077203 |
| 270.1114 | 98.015 | 0.169508 | 270.1282 | 98.559 | 0.092420 |
| 272.1280 | 97.631 | 0.205054 | 272.1334 | 98.370 | 0.114626 |
| 274.1414 | 97.192 | 0.244883 | 274.1448 | 98.140 | 0.138774 |
| 276.1582 | 96.661 | 0.287437 | 276.1525 | 97.800 | 0.168034 |
| 278.1822 | 96.036 | 0.333760 | 278.1675 | 97.483 | 0.204236 |
| 280.2045 | 95.319 | 0.380931 | 280.1890 | 97.035 | 0.244530 |
| 282.2212 | 94.491 | 0.428123 | 282.2048 | 96.444 | 0.289070 |
| 284.2391 | 93.584 | 0.474000 | 284.2312 | 95.826 | 0.340329 |
| 286.2530 | 92.581 | 0.517259 | 286.2521 | 95.154 | 0.395567 |
| 288.2604 | 91.495 | 0.557696 | 288.2794 | 94.246 | 0.455701 |
| 290.2628 | 90.337 | 0.601271 | 290.3006 | 93.276 | 0.511722 |
| 292.2676 | 89.110 | 0.627253 | 292.3199 | 92.150 | 0.565619 |
| 294.2680 | 87.816 | 0.658352 | 294.3416 | 91.012 | 0.616898 |
| 296.2638 | 86.572 | 0.685395 | 296.3513 | 89.676 | 0.667550 |
| 298.2606 | 85.063 | 0.710723 | 298.3568 | 88.300 | 0.711472 |
| 300.2607 | 83.614 | 0.740800 | 300.3612 | 86.765 | 0.749232 |
| 302.2630 | 82.124 | 0.761134 | 302.3652 | 85.294 | 0.789994 |
| 304.2644 | 80.568 | 0.787757 | 304.3583 | 83.730 | 0.821299 |
| 306.2685 | 78.993 | 0.807472 | 306.3426 | 81.992 | 0.850581 |
| 308.2661 | 77.322 | 0.819374 | 308.3419 | 80.294 | 0.874141 |
| 310.2567 | 75.691 | 0.818843 | 310.3357 | 78.528 | 0.895264 |
| 312.2279 | 73.965 | 0.828374 | 312.3268 | 76.730 | 0.919415 |
| 314.2131 | 72.511 | 0.835672 | 314.3191 | 74.807 | 0.939485 |
| 316.2190 | 70.693 | 0.867758 | 316.2928 | 72.861 | 0.956799 |
| 318.1728 | 69.049 | 0.885718 | 318.2988 | 71.054 | 0.958298 |
| 320.1754 | 67.086 | 0.893704 | 320.2866 | 69.171 | 0.964679 |
| 322.2369 | 65.482 | 0.905582 | 322.2699 | 67.245 | 0.968584 |
| 324.2172 | 63.546 | 0.896470 | 324.2587 | 65.214 | 0.958724 |
| 326.1646 | 61.776 | 0.917792 | 326.2413 | 63.371 | 0.951178 |
| 328.2206 | 60.040 | 0.908880 | 328.2116 | 61.454 | 0.939539 |
| 330.1490 | 58.085 | 0.918617 | 330.1965 | 59.644 | 0.930692 |
| 332.1872 | 56.472 | 0.926376 | 332.1880 | 57.815 | 0.924042 |

Table B-3: TGA and DTG for 2wt%, and 4wt% silica in PMMA at 20C/min

| 2wt% silica in PMMA, 20C/min | | | 4wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 334.1800 | 54.398 | 0.928400 | 334.1796 | 55.965 | 0.918810 |
| 336.1772 | 52.620 | 0.918951 | 336.1728 | 54.094 | 0.911886 |
| 338.1516 | 50.756 | 0.897040 | 338.1740 | 52.346 | 0.903888 |
| 340.0860 | 48.959 | 0.877779 | 340.1726 | 50.514 | 0.893431 |
| 342.0594 | 47.336 | 0.854842 | 342.1752 | 48.737 | 0.891166 |
| 344.0066 | 45.720 | 0.846091 | 344.1703 | 46.958 | 0.886048 |
| 346.0161 | 43.955 | 0.839022 | 346.1668 | 45.139 | 0.881956 |
| 348.0061 | 42.341 | 0.828106 | 348.1933 | 43.389 | 0.879895 |
| 350.0531 | 40.625 | 0.822602 | 350.2046 | 41.674 | 0.875915 |
| 352.0430 | 39.060 | 0.803091 | 352.2041 | 39.850 | 0.876601 |
| 354.0831 | 37.443 | 0.789959 | 354.2078 | 38.155 | 0.871753 |
| 356.0834 | 35.974 | 0.785817 | 356.2180 | 36.374 | 0.871345 |
| 358.0816 | 34.291 | 0.782510 | 358.2253 | 34.678 | 0.867138 |
| 360.1323 | 32.706 | 0.786396 | 360.2078 | 32.750 | 0.864606 |
| 362.1472 | 31.122 | 0.784262 | 362.2085 | 31.184 | 0.854116 |
| 364.1470 | 29.549 | 0.779805 | 364.1902 | 29.522 | 0.835111 |
| 366.1280 | 28.010 | 0.772075 | 366.1631 | 27.945 | 0.818435 |
| 368.1200 | 26.465 | 0.763099 | 368.1269 | 26.304 | 0.784404 |
| 370.1057 | 24.974 | 0.751324 | 370.0808 | 24.750 | 0.753395 |
| 372.0797 | 23.501 | 0.737245 | 372.0370 | 23.352 | 0.722603 |
| 374.0625 | 22.055 | 0.722405 | 373.9798 | 21.935 | 0.683178 |
| 376.0459 | 20.638 | 0.707137 | 375.9353 | 20.680 | 0.646580 |
| 378.0296 | 19.246 | 0.692277 | 377.8882 | 19.421 | 0.606773 |
| 380.0218 | 17.880 | 0.678413 | 379.8514 | 18.266 | 0.567072 |
| 382.0147 | 16.544 | 0.667561 | 381.8274 | 17.183 | 0.531665 |
| 384.0170 | 15.228 | 0.662971 | 383.8120 | 16.185 | 0.495163 |
| 386.0140 | 13.915 | 0.642685 | 385.7908 | 15.222 | 0.460780 |
| 387.9833 | 12.642 | 0.621335 | 387.7810 | 14.337 | 0.427456 |
| 389.9058 | 11.541 | 0.582942 | 389.7719 | 13.512 | 0.397765 |
| 391.7986 | 10.385 | 0.534188 | 391.7672 | 12.793 | 0.367135 |
| 393.6766 | 9.423 | 0.474373 | 393.7630 | 12.039 | 0.335775 |
| 395.5606 | 8.589 | 0.416153 | 395.7593 | 11.424 | 0.302461 |
| 397.4763 | 7.863 | 0.354006 | 397.7585 | 10.844 | 0.266606 |
| 399.4304 | 7.233 | 0.301555 | 399.7585 | 10.365 | 0.234804 |
| 401.4252 | 6.702 | 0.250579 | 401.7558 | 9.914 | 0.206904 |
| 403.4509 | 6.239 | 0.216593 | 403.7588 | 9.526 | 0.178043 |
| 405.5004 | 5.876 | 0.173904 | 405.7636 | 9.197 | 0.148450 |
| 407.5400 | 5.523 | 0.138229 | 407.7782 | 8.947 | 0.123683 |
| 409.5788 | 5.250 | 0.108391 | 409.7997 | 8.729 | 0.101287 |
| 411.6428 | 5.106 | 0.080422 | 411.8330 | 8.527 | 0.080378 |
| 413.7055 | 4.941 | 0.066633 | 413.8830 | 8.388 | 0.062367 |
| 415.7845 | 4.836 | 0.047821 | 415.9447 | 8.285 | 0.048669 |
| 417.8758 | 4.768 | 0.031827 | 418.0222 | 8.208 | 0.037976 |
| 419.9705 | 4.713 | 0.023084 | 420.0926 | 8.121 | 0.032813 |
| 422.0591 | 4.678 | 0.017371 | 422.1602 | 8.074 | 0.027010 |
| 424.1368 | 4.641 | 0.012057 | 424.2140 | 8.017 | 0.022364 |
| 426.1934 | 4.697 | 0.009142 | 426.2550 | 7.988 | 0.019614 |
| 428.2354 | 4.613 | 0.006802 | 428.2852 | 7.941 | 0.015452 |
| 430.2590 | 4.588 | 0.004606 | 430.2984 | 7.909 | 0.014144 |
| 432.2694 | 4.577 | 0.006663 | 432.3096 | 7.895 | 0.011524 |
| 434.2764 | 4.569 | 0.004454 | 434.3116 | 7.868 | 0.010263 |
| 436.2932 | 4.557 | 0.003568 | 436.3101 | 7.856 | 0.010022 |
| 438.3028 | 4.556 | 0.003227 | 438.3110 | 7.833 | 0.008134 |
| 440.2987 | 4.545 | 0.002903 | 440.3100 | 7.810 | 0.006777 |
| 442.2894 | 4.536 | 0.010360 | 442.3056 | 7.802 | 0.006235 |
| 444.2734 | 4.534 | 0.000441 | 444.3038 | 7.798 | 0.002822 |
| 446.2492 | 4.408 | -0.003934 | 446.2818 | 7.659 | 0.001923 |
| 448.2320 | 4.519 | -0.000318 | 448.2953 | 7.777 | 0.006653 |
| 450.2421 | 4.564 | -0.000201 | 450.2938 | 7.777 | 0.000727 |
| 452.2250 | 4.372 | 0.003471 | 452.2914 | 7.782 | 0.005787 |
| 454.2324 | 4.567 | 0.006779 | 454.2863 | 7.891 | 0.003228 |
| 456.2134 | 4.425 | -0.005532 | 456.2859 | 7.743 | 0.000941 |
| 458.2280 | 4.550 | 0.002439 | 458.2822 | 7.750 | 0.001126 |
| 460.2222 | 4.574 | -0.001845 | 460.2766 | 7.737 | 0.003765 |
| 462.2206 | 4.526 | 0.004870 | 462.2713 | 7.723 | 0.003446 |
| 464.2172 | 4.523 | 0.003908 | 464.2666 | 7.737 | 0.003051 |
| 466.2144 | 4.520 | 0.000720 | 466.2664 | 7.724 | 0.003761 |

Table B-3: TGA and DTG for 2wt%, and 4wt% silica in PMMA at 20C/min

| 2wt% silica in PMMA, 20C/min | | | 4wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 468.2113 | 4.527 | 0.007001 | 468.2657 | 7.720 | 0.002009 |
| 470.2078 | 4.522 | -0.001278 | 470.2606 | 7.707 | -0.000580 |
| 472.2072 | 4.524 | -0.001761 | 472.2644 | 7.728 | -0.001979 |
| 474.2055 | 4.613 | -0.001740 | 474.2648 | 7.721 | -0.002007 |
| 476.2113 | 4.522 | -0.001611 | 476.2700 | 7.729 | 0.001650 |
| 478.2152 | 4.522 | 0.003643 | 478.2707 | 7.729 | 0.006217 |
| 480.2109 | 4.518 | 0.000139 | 480.2664 | 7.726 | 0.006188 |
| 482.2120 | 4.518 | -0.000717 | 482.2716 | 7.664 | 0.002840 |
| 484.2116 | 4.527 | -0.000815 | 484.2726 | 7.693 | -0.002655 |
| 486.2093 | 4.524 | -0.000443 | 486.2761 | 7.709 | -0.004541 |
| 488.2103 | 4.524 | -0.000260 | 488.2795 | 7.733 | -0.002080 |
| 490.2120 | 4.525 | 0.006481 | 490.2772 | 7.677 | -0.000138 |
| 492.2141 | 4.527 | -0.001828 | 492.2813 | 7.713 | 0.001940 |
| 494.2164 | 4.529 | -0.002550 | 494.2813 | 7.690 | 0.000835 |
| 496.2222 | 4.653 | -0.002640 | 496.2847 | 7.697 | 0.003330 |
| 498.2250 | 4.532 | -0.002539 | 498.2850 | 7.706 | 0.007030 |
| 500.2308 | 4.535 | 0.002638 | 500.2852 | 7.701 | -0.003214 |
| 502.2308 | 4.527 | 0.000744 | 502.2746 | 7.649 | -0.003071 |
| 504.2384 | 4.532 | -0.000348 | 504.2960 | 7.787 | -0.003824 |
| 506.2428 | 4.532 | 0.001217 | 506.2980 | 7.700 | -0.003846 |
| 508.2450 | 4.532 | -0.002052 | 508.3017 | 7.695 | 0.008672 |
| 510.2304 | 4.354 | -0.002354 | 510.3029 | 7.686 | 0.002157 |
| 512.2474 | 4.553 | -0.002526 | 512.3062 | 7.689 | 0.001021 |
| 514.2496 | 4.536 | -0.002138 | 514.3040 | 7.679 | 0.001780 |
| 516.2507 | 4.540 | 0.003146 | 516.3108 | 7.689 | 0.000160 |
| 518.2539 | 4.533 | -0.000652 | 518.3142 | 7.680 | -0.002157 |
| 520.2579 | 4.541 | -0.001123 | 520.3169 | 7.759 | -0.002047 |
| 522.2640 | 4.539 | -0.001506 | 522.3313 | 7.695 | -0.002089 |
| 524.2672 | 4.541 | -0.000499 | 524.3351 | 7.679 | -0.002044 |
| 526.2699 | 4.540 | -0.000298 | 526.3360 | 7.682 | 0.001907 |
| 528.2754 | 4.542 | 0.000965 | 528.3424 | 7.686 | 0.000138 |
| 530.2824 | 4.552 | -0.001685 | 530.3428 | 7.684 | 0.000363 |
| 532.2813 | 4.533 | -0.001824 | 532.3422 | 7.679 | -0.000219 |
| 534.2860 | 4.586 | -0.001183 | 534.3394 | 7.682 | -0.000728 |
| 536.2890 | 4.550 | -0.001836 | 536.3400 | 7.690 | -0.000830 |
| 538.2940 | 4.547 | 0.008502 | 538.3411 | 7.693 | -0.000562 |
| 540.2970 | 4.557 | -0.002272 | 540.3449 | 7.685 | 0.000044 |
| 542.3004 | 4.568 | 0.004977 | 542.3501 | 7.686 | 0.000129 |
| 544.3046 | 4.658 | -0.002593 | 544.3542 | 7.688 | -0.000480 |
| 546.3129 | 4.567 | -0.006037 | 546.3591 | 7.686 | 0.001223 |
| 548.3161 | 4.678 | 0.000165 | 548.3604 | 7.690 | -0.001987 |
| 550.3254 | 4.591 | -0.004027 | 550.3492 | 7.536 | -0.002126 |
| 552.3256 | 4.556 | 0.009839 | 552.3678 | 7.702 | -0.002581 |
| 554.3253 | 4.560 | 0.000117 | 554.3726 | 7.694 | -0.002629 |
| 556.3210 | 4.569 | 0.000051 | 556.3741 | 7.698 | 0.003460 |
| 558.3195 | 4.645 | 0.002208 | 558.3772 | 7.690 | 0.000247 |
| 560.3222 | 4.575 | -0.005606 | 560.3774 | 7.692 | 0.000147 |
| 562.3121 | 4.494 | 0.004642 | 562.3765 | 7.692 | -0.000534 |
| 564.3284 | 4.618 | -0.006451 | 564.3850 | 7.687 | 0.004799 |
| 566.3355 | 4.560 | -0.009106 | 566.3900 | 7.694 | -0.002048 |
| 568.3369 | 4.736 | 0.002083 | 568.3868 | 7.557 | -0.002362 |
| 570.3455 | 4.595 | 0.001223 | 570.4030 | 7.741 | -0.001041 |
| 572.3471 | 4.588 | 0.009229 | 572.4108 | 7.701 | -0.005851 |
| 574.3444 | 4.522 | -0.001705 | 574.4016 | 7.603 | 0.002144 |
| 576.3500 | 4.631 | -0.003303 | 576.4230 | 7.730 | -0.003606 |
| 578.3562 | 4.666 | -0.007077 | 578.4238 | 7.705 | -0.004199 |
| 580.3500 | 4.481 | 0.001391 | 580.4266 | 7.708 | 0.003710 |
| 582.3664 | 4.611 | 0.003658 | 582.4241 | 7.709 | -0.001071 |
| 584.3708 | 4.592 | -0.002476 | 584.4278 | 7.709 | -0.000865 |
| 586.3756 | 4.589 | 0.002557 | 586.4305 | 7.720 | -0.000811 |
| 588.3810 | 4.590 | 0.002649 | 588.4346 | 7.711 | -0.000441 |
| 590.3844 | 4.596 | -0.002383 | 590.4354 | 7.716 | -0.000908 |
| 592.3863 | 4.608 | -0.003252 | 592.4410 | 7.715 | -0.001203 |
| 594.3852 | 4.731 | -0.003252 | 594.4439 | 7.721 | -0.000794 |
| 596.3942 | 4.612 | -0.002848 | 596.4532 | 7.714 | -0.001134 |
| 598.3960 | 4.608 | 0.004273 | 598.4570 | 7.727 | -0.000565 |
| 600.4029 | 4.608 | -0.001117 | 600.4626 | 7.724 | -0.000252 |

Table B-3: TGA and DTG for 2wt%, and 4wt% silica in PMMA at 20C/min

| 2wt% silica in PMMA, 20C/min | | | 4wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 602.4068 | 4.616 | -0.002489 | 602.4671 | 7.720 | -0.000208 |
| 604.4124 | 4.673 | -0.002291 | 604.4716 | 7.721 | -0.000401 |
| 606.4210 | 4.616 | -0.002329 | 606.4774 | 7.725 | -0.001001 |
| 608.4219 | 4.610 | 0.004743 | 608.4810 | 7.721 | -0.001235 |
| 610.4230 | 4.622 | -0.001413 | 610.4800 | 7.732 | -0.001259 |
| 612.4235 | 4.620 | -0.001182 | 612.4819 | 7.732 | -0.000420 |
| 614.4226 | 4.629 | 0.002296 | 614.4850 | 7.740 | -0.000456 |
| 616.4209 | 4.616 | -0.002036 | 616.4852 | 7.732 | -0.000108 |
| 618.4112 | 4.437 | -0.004625 | 618.4868 | 7.743 | 0.000042 |
| 620.4222 | 4.594 | -0.005765 | 620.4895 | 7.734 | -0.001135 |
| 622.4326 | 4.644 | -0.003284 | 622.4932 | 7.731 | -0.001013 |
| 624.4368 | 4.636 | 0.000080 | 624.4971 | 7.743 | -0.001166 |
| 626.4291 | 4.485 | -0.000602 | 626.4992 | 7.740 | -0.000875 |
| 628.4468 | 4.657 | -0.002702 | 628.5060 | 7.742 | 0.000110 |
| 630.4496 | 4.645 | -0.003680 | 630.5123 | 7.745 | -0.000492 |
| 632.4508 | 4.649 | 0.001168 | 632.5168 | 7.741 | -0.000179 |
| 634.4461 | 4.633 | -0.002651 | 634.5220 | 7.750 | -0.000651 |
| 636.4570 | 4.654 | -0.002503 | 636.5287 | 7.746 | -0.000804 |
| 638.4609 | 4.651 | -0.002979 | 638.5312 | 7.751 | -0.000768 |
| 640.4619 | 4.633 | 0.002964 | 640.5322 | 7.746 | -0.001702 |
| 642.4615 | 4.643 | 0.008835 | 642.5344 | 7.751 | -0.001398 |
| 644.4644 | 4.642 | -0.004435 | 644.5354 | 7.766 | -0.001231 |
| 646.4566 | 4.409 | -0.004649 | 646.5400 | 7.764 | -0.000897 |
| 648.4822 | 4.740 | -0.004656 | 648.5406 | 7.758 | -0.000707 |
| 650.4875 | 4.663 | -0.002803 | 650.5453 | 7.750 | -0.002844 |
| 652.4907 | 4.644 | 0.006722 | 652.5382 | 7.584 | -0.002694 |
| 654.4839 | 4.477 | -0.002103 | 654.5528 | 7.784 | -0.003029 |
| 656.4988 | 4.679 | -0.002826 | 656.5547 | 7.772 | -0.001122 |
| 658.5046 | 4.655 | -0.002367 | 658.5557 | 7.775 | 0.001653 |
| 660.5032 | 4.665 | 0.003409 | 660.5576 | 7.769 | 0.000244 |
| 662.5008 | 4.664 | 0.000696 | 662.5624 | 7.762 | 0.000100 |
| 664.5024 | 4.672 | -0.002028 | 664.5680 | 7.759 | -0.000277 |
| 666.4976 | 4.512 | -0.002622 | 666.5801 | 7.780 | 0.000194 |
| 668.5146 | 4.681 | -0.001941 | 668.5822 | 7.762 | -0.001585 |
| 670.5218 | 4.671 | -0.002535 | 670.5876 | 7.781 | -0.001749 |
| 672.5272 | 4.668 | 0.002010 | 672.5926 | 7.795 | -0.002244 |
| 674.5271 | 4.662 | -0.000728 | 674.5938 | 7.789 | -0.000291 |
| 676.5278 | 4.672 | -0.001564 | 676.5930 | 7.777 | 0.007992 |
| 678.5336 | 4.666 | -0.000892 | 678.5972 | 7.783 | -0.000670 |
| 680.5358 | 4.680 | -0.000884 | 680.6001 | 7.784 | -0.001338 |
| 682.5405 | 4.667 | -0.002046 | 682.6011 | 7.859 | -0.002300 |
| 684.5444 | 4.749 | -0.002282 | 684.6050 | 7.772 | -0.003229 |
| 686.5511 | 4.688 | -0.003950 | 686.6071 | 7.785 | 0.002601 |
| 688.5482 | 4.777 | -0.004187 | 688.6056 | 7.791 | -0.000102 |
| 690.5552 | 4.680 | -0.000124 | 690.6080 | 7.774 | -0.000629 |
| 692.5593 | 4.686 | -0.001539 | 692.6089 | 7.780 | -0.000555 |
| 694.5638 | 4.677 | 0.011552 | 694.6120 | 7.799 | -0.001385 |
| 696.5676 | 4.670 | -0.003822 | 696.6190 | 7.799 | -0.000842 |
| 698.5634 | 4.475 | -0.002044 | 698.6228 | 7.796 | 0.000217 |
| 700.5801 | 4.802 | -0.007518 | 700.6290 | 7.802 | -0.000043 |
| 702.5772 | 4.692 | -0.007671 | 702.6270 | 7.801 | -0.000206 |
| 704.5748 | 4.796 | 0.007927 | 704.6368 | 7.811 | -0.000397 |
| 706.5772 | 4.700 | 0.000068 | 706.6384 | 7.792 | -0.000481 |
| 708.5774 | 4.682 | 0.000424 | 708.6475 | 7.799 | -0.000533 |
| 710.5760 | 4.680 | -0.000717 | 710.6485 | 7.796 | 0.004312 |
| 712.5832 | 4.685 | -0.001606 | 712.6536 | 7.805 | 0.000007 |
| 714.5886 | 4.703 | -0.000084 | 714.6554 | 7.784 | -0.004145 |
| 716.5929 | 4.677 | 0.000754 | 716.6553 | 7.825 | -0.004560 |
| 718.5947 | 4.683 | 0.001853 | 718.6643 | 7.825 | -0.004812 |
| 720.5986 | 4.674 | 0.000886 | 720.6620 | 7.803 | -0.001011 |
| 722.5996 | 4.674 | -0.000788 | 722.6619 | 7.801 | 0.003734 |
| 724.6025 | 4.684 | -0.002881 | 724.6664 | 7.809 | -0.000547 |
| 726.6036 | 4.781 | 0.002018 | 726.6699 | 7.804 | -0.001166 |
| 728.6156 | 4.699 | -0.001699 | 728.6738 | 7.813 | -0.000666 |
| 730.6243 | 4.681 | -0.004704 | 730.6759 | 7.807 | -0.000915 |
| 732.6241 | 4.736 | -0.002209 | 732.6813 | 7.805 | 0.000187 |
| 734.6376 | 4.698 | -0.004693 | 734.6831 | 7.819 | -0.000093 |

Table B-3: TGA and DTG for 2wt%, and 4wt% silica in PMMA at 20C/min

| 2wt% silica in PMMA, 20C/min | | | 4wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 736.6325 | 4.688 | 0.005356 | 736.6876 | 7.807 | -0.000878 |
| 738.6288 | 4.688 | -0.000317 | 738.6884 | 7.805 | -0.000868 |
| 740.6190 | 4.529 | -0.000286 | 740.6878 | 7.809 | -0.001071 |
| 742.6350 | 4.779 | -0.005840 | 742.6993 | 7.816 | -0.001616 |
| 744.6410 | 4.696 | -0.007038 | 744.7042 | 7.808 | -0.000998 |
| 746.6452 | 4.830 | 0.007576 | 746.7113 | 7.827 | 0.009481 |
| 748.6512 | 4.690 | -0.000569 | 748.7168 | 7.818 | 0.002772 |
| 750.6490 | 4.689 | -0.000540 | 750.7214 | 7.803 | -0.003590 |
| 752.6500 | 4.692 | 0.001060 | 752.7231 | 7.778 | -0.005750 |
| 754.6496 | 4.692 | 0.000641 | 754.7400 | 7.850 | -0.006759 |
| 756.6536 | 4.682 | 0.001135 | 756.7362 | 7.830 | 0.002427 |
| 758.6594 | 4.677 | 0.001216 | 758.7390 | 7.806 | 0.008336 |
| 760.6653 | 4.679 | 0.000002 | 760.7370 | 7.810 | 0.001446 |
| 762.6751 | 4.682 | -0.000322 | 762.7324 | 7.784 | -0.002954 |
| 764.6828 | 4.689 | -0.000040 | 764.7368 | 7.808 | -0.003170 |
| 766.6834 | 4.684 | 0.000323 | 766.7474 | 7.855 | -0.002625 |
| 768.6869 | 4.682 | -0.000605 | 768.7550 | 7.829 | 0.000514 |
| 770.6922 | 4.683 | -0.001500 | 770.7622 | 7.819 | 0.011726 |
| 772.6953 | 4.693 | -0.001675 | 772.7610 | 7.806 | -0.000051 |
| 774.6975 | 4.693 | -0.000935 | 774.7594 | 7.823 | -0.006322 |
| 776.6968 | 4.695 | -0.000220 | 776.7519 | 7.797 | -0.006174 |
| 778.6956 | 4.704 | 0.000538 | 778.7661 | 7.854 | -0.005927 |
| 780.6984 | 4.695 | 0.000963 | 780.7630 | 7.828 | 0.001961 |
| 782.7111 | 4.684 | 0.000542 | 782.7621 | 7.823 | 0.006165 |
| 784.7212 | 4.680 | 0.000428 | 784.7650 | 7.809 | -0.000519 |
| 786.7266 | 4.682 | -0.000085 | 786.7674 | 7.824 | -0.000367 |
| 788.7256 | 4.687 | -0.000424 | 788.7701 | 7.851 | -0.002706 |
| 790.7250 | 4.690 | -0.000415 | 790.7753 | 7.828 | 0.000139 |
| 792.7270 | 4.697 | -0.000053 | 792.7807 | 7.849 | 0.000476 |
| 794.7278 | 4.698 | 0.001159 | 794.7880 | 7.828 | -0.000959 |
| 796.7272 | 4.679 | -0.000418 | 796.7922 | 7.834 | -0.000139 |
| 798.7237 | 4.672 | -0.000287 | 798.7914 | 7.820 | -0.000595 |
| 800.7226 | 4.701 | -0.001260 | 800.7886 | 7.842 | 0.000473 |
| 802.7245 | 4.686 | -0.001269 | 802.7908 | 7.834 | 0.001698 |
| 804.7320 | 4.684 | 0.004123 | 804.7962 | 7.831 | 0.000510 |
| 806.7392 | 4.680 | -0.001229 | 806.7956 | 7.829 | -0.000341 |
| 808.7388 | 4.647 | -0.001339 | 808.8040 | 7.836 | -0.000714 |
| 810.7454 | 4.741 | -0.001794 | 810.8086 | 7.825 | -0.001266 |
| 812.7512 | 4.686 | -0.002514 | 812.8130 | 7.825 | -0.000160 |
| 814.7555 | 4.685 | 0.003183 | 814.8112 | 7.850 | -0.001479 |
| 816.7569 | 4.698 | 0.001118 | 816.8144 | 7.829 | -0.000407 |
| 818.7516 | 4.681 | 0.004803 | 818.8168 | 7.851 | -0.000207 |
| 820.7610 | 4.686 | 0.000116 | 820.8199 | 7.843 | 0.000748 |
| 822.7611 | 4.679 | -0.003008 | 822.8212 | 7.849 | 0.002032 |
| 824.7609 | 4.812 | -0.002602 | 824.8225 | 7.836 | 0.000671 |
| 826.7657 | 4.707 | -0.002554 | 826.8314 | 7.831 | -0.000229 |
| 828.7671 | 4.689 | -0.000880 | 828.8301 | 7.842 | -0.002068 |
| 830.7725 | 4.690 | 0.002498 | 830.8364 | 7.840 | -0.002501 |
| 832.7774 | 4.689 | 0.000302 | 832.8363 | 7.834 | -0.000523 |
| 834.7834 | 4.691 | 0.000562 | 834.8392 | 7.861 | 0.000586 |
| 836.7879 | 4.691 | -0.000064 | 836.8412 | 7.847 | 0.001150 |
| 838.7968 | 4.683 | 0.001999 | 838.8445 | 7.821 | 0.003439 |
| 840.8003 | 4.675 | -0.000116 | 840.8501 | 7.833 | 0.002586 |
| 842.7995 | 4.672 | -0.000822 | 842.8495 | 7.809 | 0.002157 |
| 844.8064 | 4.713 | -0.000823 | 844.8539 | 7.819 | -0.000968 |
| 846.8041 | 4.690 | 0.008269 | 846.8570 | 7.828 | -0.002305 |
| 848.7980 | 4.684 | -0.000032 | 848.8611 | 7.854 | -0.001953 |
| 850.7992 | 4.681 | -0.001568 | 850.8595 | 7.817 | -0.001068 |
| 852.8025 | 4.799 | -0.002430 | 852.8651 | 7.838 | 0.001169 |
| 854.8031 | 4.701 | -0.002562 | 854.8659 | 7.833 | -0.000401 |
| 856.8009 | 4.681 | 0.002986 | 856.8718 | 7.820 | -0.001438 |
| 858.8069 | 4.679 | 0.009284 | 858.8712 | 7.841 | -0.002030 |
| 860.8092 | 4.683 | -0.001349 | 860.8744 | 7.844 | -0.001768 |
| 862.8106 | 4.668 | -0.002938 | 862.8804 | 7.856 | 0.001276 |
| 864.8156 | 4.766 | -0.002681 | 864.8791 | 7.834 | 0.002098 |
| 866.8196 | 4.701 | -0.002812 | 866.8811 | 7.848 | 0.002466 |
| 868.8194 | 4.689 | 0.002530 | 868.8871 | 7.835 | 0.001007 |

Table B-3: TGA and DTG for 2wt%, and 4wt% silica in PMMA at 20C/min

| 2wt% silica in PMMA, 20C/min | | | 4wt% silica in PMMA, 20C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 870.8134 | 4.670 | 0.000061 | 870.8869 | 7.810 | 0.004745 |
| 872.8262 | 4.705 | -0.000224 | 872.8926 | 7.807 | -0.003579 |
| 874.8296 | 4.659 | -0.002002 | 874.8922 | 7.568 | -0.004358 |
| 876.8332 | 4.653 | 0.004188 | 876.9051 | 7.887 | -0.006087 |
| 878.8342 | 4.684 | 0.007837 | 878.9022 | 7.862 | -0.004168 |
| 880.8431 | 4.684 | -0.002718 | 880.9012 | 7.861 | 0.007262 |
| 882.8364 | 4.374 | -0.002873 | 882.8976 | 7.845 | 0.001414 |
| 884.8501 | 4.737 | -0.003111 | 884.8957 | 7.832 | 0.002820 |
| 886.8528 | 4.677 | -0.005295 | 886.8994 | 7.840 | 0.002066 |
| 888.8496 | 4.670 | 0.007961 | 888.9056 | 7.831 | -0.000272 |
| 890.8492 | 4.698 | -0.001058 | 890.9151 | 7.814 | 0.000052 |
| 892.8475 | 4.669 | -0.001426 | 892.9199 | 7.849 | -0.000979 |
| 894.8539 | 4.684 | -0.000183 | 894.9191 | 7.842 | -0.000892 |
| 896.8566 | 4.671 | 0.000234 | 896.9209 | 7.829 | 0.000335 |
| 898.8658 | 4.696 | -0.000272 | 898.9196 | 7.841 | -0.000339 |
| 900.8702 | 4.650 | 0.002839 | 900.9241 | 7.839 | -0.001638 |
| 902.8758 | 4.677 | 0.003003 | 902.9257 | 7.834 | -0.000745 |
| 904.8769 | 4.637 | 0.001184 | 904.9324 | 7.847 | 0.006936 |
| 906.8788 | 4.662 | 0.000349 | 906.9340 | 7.840 | -0.001956 |
| 908.8796 | 4.673 | -0.001774 | 908.9330 | 7.614 | -0.002556 |
| 910.8814 | 4.685 | 0.000361 | 910.9439 | 7.896 | -0.003606 |
| 912.8811 | 4.674 | 0.001942 | 912.9481 | 7.844 | -0.003450 |
| 914.8788 | 4.665 | 0.002247 | 914.9469 | 7.855 | 0.007904 |
| 916.8832 | 4.684 | 0.000416 | 916.9516 | 7.840 | -0.000408 |
| 918.8841 | 4.654 | 0.001097 | 918.9504 | 7.845 | -0.000495 |
| 920.8895 | 4.679 | 0.000264 | 920.9532 | 7.852 | -0.000838 |
| 922.8903 | 4.661 | 0.011353 | 922.9532 | 7.836 | 0.001841 |
| 924.8959 | 4.657 | -0.000813 | 924.9594 | 7.847 | 0.001079 |
| 926.8889 | 4.329 | -0.007887 | 926.9590 | 7.837 | -0.000313 |
| 928.8972 | 4.525 | -0.008491 | 928.9632 | 7.860 | -0.001254 |
| 930.9019 | 4.705 | 0.004068 | 930.9602 | 7.845 | -0.000975 |
| 932.9049 | 4.681 | 0.011618 | 932.9656 | 7.870 | -0.000072 |
| 934.8985 | 4.589 | 0.002538 | 934.9647 | 7.840 | 0.001411 |
| 936.9061 | 4.797 | -0.007793 | 936.9706 | 7.853 | 0.003758 |
| 938.9080 | 4.825 | -0.017806 | 938.9668 | 7.822 | 0.003187 |
| 940.9110 | 4.674 | 0.007701 | 940.9705 | 7.828 | 0.007044 |

Table B-4: XRD Data for PMMA, 1wt%, 2wt%, and 4wt% Silica in PMMA

| Pure PMMA | | 1wt% Silica in PMMA | | 2wt% Silica in PMMA | | 4wt% Silica in PMMA | |
|---|---|---|---|---|---|---|---|
| 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) | 2Θ (°) | Intensity (AU) |
| 6.0237 | 1878 | 6.109 | 10290 | 6.0237 | 17518 | 6.0237 | 24061 |
| 7.0474 | 1940 | 7.218 | 10510 | 7.0474 | 17608 | 7.0474 | 24268 |
| 8.071 | 2330 | 8.327 | 10922 | 8.071 | 18106 | 8.071 | 24465 |
| 9.0947 | 2718 | 9.436 | 11569 | 9.0947 | 18732 | 9.0947 | 24954 |
| 10.1184 | 3417 | 10.5449 | 12482 | 10.1184 | 19261 | 10.1184 | 25570 |
| 11.1421 | 4432 | 11.6539 | 14010 | 11.1421 | 20805 | 11.1421 | 26590 |
| 12.1658 | 6108 | 12.7629 | 15411 | 12.1658 | 22447 | 12.1658 | 28452 |
| 13.1895 | 7247 | 13.8719 | 15711 | 13.1895 | 23685 | 13.1895 | 29533 |
| 14.2131 | 7147 | 14.9809 | 15132 | 14.2131 | 23714 | 14.2131 | 29979 |
| 15.2368 | 6749 | 16.0899 | 14297 | 15.2368 | 23134 | 15.2368 | 29746 |
| 16.2605 | 6337 | 17.1989 | 13478 | 16.2605 | 22438 | 16.2605 | 29537 |
| 17.2842 | 5756 | 18.3079 | 12523 | 17.2842 | 21591 | 17.2842 | 29018 |
| 18.3079 | 5142 | 19.4168 | 11706 | 18.3079 | 20812 | 18.3079 | 28613 |
| 19.3316 | 4767 | 20.5258 | 11027 | 19.3316 | 20095 | 19.3316 | 27979 |
| 20.3552 | 4140 | 21.6348 | 10752 | 20.3552 | 19493 | 20.3552 | 27608 |
| 21.3789 | 3747 | 22.7438 | 10427 | 21.3789 | 18798 | 21.3789 | 27124 |
| 22.4026 | 3449 | 23.8528 | 10165 | 22.4026 | 18459 | 22.4026 | 26709 |
| 23.4263 | 3404 | 24.9618 | 10265 | 23.4263 | 18178 | 23.4263 | 26523 |
| 24.45 | 3397 | 26.0708 | 10379 | 24.45 | 18092 | 24.45 | 26503 |
| 25.4737 | 3567 | 27.1797 | 10674 | 25.4737 | 18043 | 25.4737 | 26513 |
| 26.4973 | 3583 | 28.2887 | 10841 | 26.4973 | 18354 | 26.4973 | 26610 |
| 27.521 | 4014 | 29.3977 | 10988 | 27.521 | 18566 | 27.521 | 26841 |
| 28.5447 | 4174 | 30.5067 | 11039 | 28.5447 | 18732 | 28.5447 | 27192 |
| 29.5684 | 4212 | 31.6157 | 10993 | 29.5684 | 18886 | 29.5684 | 27207 |
| 30.5921 | 4338 | 32.7247 | 10824 | 30.5921 | 19026 | 30.5921 | 27242 |
| 31.6157 | 4297 | 33.8337 | 10646 | 31.6157 | 18923 | 31.6157 | 27084 |
| 32.6394 | 4207 | 34.9427 | 10469 | 32.6394 | 18672 | 32.6394 | 27015 |
| 33.6631 | 4078 | 36.0516 | 10358 | 33.6631 | 18421 | 33.6631 | 26803 |
| 34.6868 | 3982 | 37.1606 | 10305 | 34.6868 | 18263 | 34.6868 | 26489 |
| 35.7105 | 3746 | 38.2696 | 10231 | 35.7105 | 17988 | 35.7105 | 26410 |
| 36.7342 | 3618 | 39.3786 | 10329 | 36.7342 | 17971 | 36.7342 | 26367 |
| 37.7578 | 3674 | 40.4876 | 10412 | 37.7578 | 17927 | 37.7578 | 26336 |
| 38.7815 | 3632 | 41.5966 | 10355 | 38.7815 | 17883 | 38.7815 | 26287 |
| 39.8052 | 3603 | 42.7056 | 11069 | 39.8052 | 18017 | 39.8052 | 26294 |
| 40.8289 | 3653 | 43.8146 | 10943 | 40.8289 | 18054 | 40.8289 | 26314 |
| 41.8526 | 3712 | 44.9235 | 10211 | 41.8526 | 18189 | 41.8526 | 26518 |
| 42.8763 | 5369 | 46.0325 | 10180 | 42.8763 | 19737 | 42.8763 | 28004 |
| 43.8999 | 4348 | 47.1415 | 10048 | 43.8999 | 18405 | 43.8999 | 26832 |
| 44.9236 | 3579 | 48.2505 | 10006 | 44.9236 | 17898 | 44.9236 | 26268 |
| 45.9473 | 3484 | 49.3595 | 10131 | 45.9473 | 17590 | 45.9473 | 26185 |
| 46.971 | 3385 | 50.4685 | 10371 | 46.971 | 17660 | 46.971 | 25952 |
| 47.9947 | 3255 | 51.5775 | 10015 | 47.9947 | 17595 | 47.9947 | 26090 |
| 49.0183 | 3336 | 52.6865 | 9987 | 49.0183 | 17586 | 49.0183 | 26031 |
| 50.042 | 4129 | 53.7954 | 9938 | 50.042 | 18384 | 50.042 | 26791 |
| 51.0657 | 3313 | 54.9044 | 10092 | 51.0657 | 17569 | 51.0657 | 25942 |

Table B-5: Heat Release Rate Data from Cone Calorimetry

| Pure PMMA | | 1wt% silica cross-linkaged to PMMA | | traditional 1wt% silica inPMMA | |
|---|---|---|---|---|---|
| Time (s) | HRR(kW/m^2) | Time (s) | HRR(kW/m^2) | Time (s) | HRR(kW/m^2) |
| 4.25 | -3.2 | 0.24 | 0.0 | 0.59 | 0.0 |
| 8.88 | 0.0 | 4.41 | 0.8 | 6.51 | 2.2 |
| 19.31 | 0.0 | 5.50 | 17.9 | 10.06 | 5.0 |
| 25.10 | 6.3 | 6.62 | 49.1 | 14.79 | 16.5 |
| 26.25 | 28.6 | 7.74 | 80.4 | 15.98 | 25.2 |
| 27.41 | 57.1 | 8.86 | 108.8 | 19.53 | 45.3 |
| 28.57 | 76.2 | 10.01 | 151.4 | 20.71 | 56.8 |
| 29.73 | 95.2 | 11.10 | 168.4 | 23.08 | 79.9 |
| 30.89 | 114.3 | 12.19 | 188.3 | 24.26 | 91.4 |
| 32.05 | 133.3 | 13.28 | 208.2 | 25.44 | 102.9 |
| 33.20 | 155.6 | 15.46 | 245.1 | 26.63 | 111.5 |
| 34.36 | 171.4 | 16.53 | 256.5 | 27.81 | 123.0 |
| 35.52 | 190.5 | 18.67 | 276.4 | 28.99 | 134.5 |
| 36.68 | 209.5 | 20.81 | 296.4 | 31.36 | 154.7 |
| 37.84 | 222.2 | 22.92 | 307.8 | 32.54 | 163.3 |
| 40.15 | 250.8 | 26.10 | 327.7 | 33.73 | 174.8 |
| 42.47 | 273.0 | 29.29 | 353.3 | 36.09 | 195.0 |
| 44.79 | 298.4 | 27.17 | 339.1 | 37.28 | 206.5 |
| 45.95 | 330.2 | 30.37 | 367.5 | 38.46 | 218.0 |
| 47.10 | 355.6 | 32.50 | 387.5 | 39.64 | 229.5 |
| 48.26 | 387.3 | 34.65 | 413.1 | 40.83 | 243.9 |
| 49.42 | 419.0 | 36.79 | 435.8 | 42.01 | 255.4 |
| 50.58 | 441.3 | 39.98 | 458.6 | 43.20 | 269.8 |
| 51.74 | 460.3 | 42.12 | 481.4 | 44.38 | 284.2 |
| 52.90 | 479.4 | 45.38 | 532.5 | 45.56 | 298.6 |
| 54.05 | 498.4 | 44.29 | 515.5 | 46.75 | 321.6 |
| 55.21 | 514.3 | 47.57 | 572.3 | 47.93 | 336.0 |
| 56.37 | 523.8 | 48.68 | 600.7 | 49.11 | 350.4 |
| 58.69 | 539.7 | 49.81 | 634.8 | 50.30 | 367.6 |
| 61.00 | 555.6 | 50.91 | 657.5 | 51.48 | 376.3 |
| 62.16 | 565.1 | 52.03 | 685.9 | 52.66 | 387.8 |
| 64.48 | 581.0 | 54.17 | 708.6 | 55.03 | 405.0 |
| 66.80 | 590.5 | 56.33 | 737.1 | 56.21 | 419.4 |
| 70.27 | 603.2 | 55.26 | 725.7 | 57.40 | 430.9 |
| 74.90 | 615.9 | 61.51 | 728.7 | 58.58 | 445.3 |
| 77.22 | 631.7 | 63.52 | 700.4 | 60.95 | 465.5 |
| 79.54 | 650.8 | 64.52 | 683.4 | 63.31 | 479.9 |
| 85.33 | 647.6 | 65.52 | 666.4 | 64.50 | 488.5 |
| 87.64 | 663.5 | 66.52 | 652.3 | 66.86 | 505.8 |
| 89.96 | 679.4 | 68.56 | 635.3 | 69.23 | 520.1 |
| 91.12 | 695.2 | 71.64 | 615.5 | 71.60 | 537.4 |
| 92.28 | 707.9 | 74.69 | 587.2 | 73.96 | 551.8 |
| 93.44 | 723.8 | 72.66 | 607.0 | 76.33 | 563.3 |
| 94.59 | 739.7 | 76.72 | 567.4 | 78.70 | 577.7 |
| 100.39 | 749.2 | 81.91 | 561.9 | 79.88 | 589.2 |
| 105.02 | 771.4 | 87.14 | 570.6 | 85.80 | 569.1 |
| 107.34 | 749.2 | 91.27 | 556.5 | 90.53 | 589.2 |
| 109.65 | 723.8 | 95.37 | 528.3 | 95.27 | 597.8 |
| 111.97 | 746.0 | 97.41 | 514.1 | 100.00 | 586.3 |
| 115.44 | 781.0 | 99.48 | 505.7 | 104.73 | 600.7 |
| 120.08 | 758.7 | 101.54 | 497.2 | 110.65 | 595.0 |
| 122.39 | 736.5 | 104.63 | 486.0 | 115.38 | 626.6 |
| 124.71 | 717.5 | 110.83 | 466.3 | 120.12 | 623.7 |
| 125.87 | 701.6 | 113.91 | 449.3 | 124.85 | 638.1 |
| 127.03 | 685.7 | 116.99 | 429.6 | 127.22 | 629.5 |
| 128.19 | 669.8 | 120.06 | 409.8 | 131.95 | 612.2 |
| 129.34 | 654.0 | 123.13 | 390.0 | 135.50 | 597.8 |
| 130.50 | 638.1 | 126.21 | 370.3 | 139.05 | 583.5 |
| 132.82 | 622.2 | 131.37 | 353.4 | 141.42 | 569.1 |
| 135.14 | 606.3 | 134.45 | 336.5 | 142.60 | 554.7 |
| 135.14 | 596.8 | 138.57 | 316.7 | 143.79 | 540.3 |
| 136.29 | 571.4 | 141.67 | 308.3 | 144.97 | 528.8 |
| 137.45 | 536.5 | 144.77 | 297.0 | 147.34 | 514.4 |
| 138.61 | 504.8 | 146.82 | 285.7 | 148.52 | 502.9 |
| 138.61 | 495.2 | 150.94 | 268.8 | 150.89 | 488.5 |
| 139.77 | 469.8 | 156.11 | 254.8 | 153.25 | 474.1 |

Table B-5: Continued

| Pure PMMA | | 1wt% silica cross-linkaged to PMMA | | traditional 1wt% silica inPMMA | |
|---|---|---|---|---|---|
| Time (s) | HRR(kW/m^2) | Time (s) | HRR(kW/m^2) | Time (s) | HRR(kW/m^2) |
| 136.29 | 558.7 | 159.20 | 240.7 | 154.44 | 462.6 |
| 137.45 | 527.0 | 162.30 | 229.4 | 155.62 | 451.1 |
| 140.93 | 447.6 | 165.39 | 218.2 | 156.80 | 442.4 |
| 142.08 | 425.4 | 171.61 | 207.0 | 157.99 | 430.9 |
| 143.24 | 406.3 | 175.76 | 198.6 | 159.17 | 419.4 |
| 144.40 | 384.1 | 179.89 | 184.6 | 160.36 | 405.0 |
| 145.56 | 365.1 | 186.12 | 176.2 | 161.54 | 390.6 |
| 146.72 | 349.2 | 192.35 | 167.9 | 162.72 | 376.3 |
| 147.88 | 333.3 | 196.49 | 159.5 | 163.91 | 364.7 |
| 149.03 | 314.3 | 206.89 | 151.3 | 165.09 | 353.2 |
| 150.19 | 298.4 | 215.20 | 143.0 | 166.27 | 341.7 |
| 154.83 | 285.7 | 221.44 | 140.3 | 167.46 | 321.6 |
| 161.78 | 276.2 | 228.71 | 132.0 | 168.64 | 307.2 |
| 168.73 | 266.7 | 237.02 | 120.9 | 169.82 | 292.8 |
| 174.52 | 260.3 | 246.37 | 112.7 | 172.19 | 278.4 |
| 181.47 | 250.8 | 251.56 | 107.2 | 174.56 | 266.9 |
| 188.42 | 238.1 | 260.91 | 96.1 | 176.92 | 255.4 |
| 195.37 | 234.9 | 266.09 | 84.9 | 179.29 | 243.9 |
| 200.00 | 228.6 | 270.23 | 76.5 | 181.66 | 235.3 |
| 205.79 | 212.7 | 277.50 | 65.3 | 184.02 | 223.7 |
| 210.42 | 196.8 | 285.80 | 54.2 | 186.39 | 215.1 |
| 216.22 | 184.1 | 293.07 | 45.9 | 189.94 | 209.4 |
| 223.17 | 168.3 | 299.31 | 40.4 | 193.49 | 200.7 |
| 226.64 | 158.7 | 306.58 | 35.0 | 198.22 | 192.1 |
| 231.27 | 146.0 | 316.99 | 32.4 | 201.78 | 183.5 |
| 234.75 | 133.3 | 325.33 | 32.6 | 206.51 | 171.9 |
| 239.38 | 123.8 | 335.73 | 27.3 | 211.24 | 163.3 |
| 242.86 | 114.3 | 343.01 | 21.8 | 214.79 | 157.6 |
| 246.33 | 104.8 | 348.21 | 19.1 | 220.71 | 143.2 |
| 249.81 | 95.2 | 358.61 | 13.7 | 225.44 | 131.7 |
| 253.28 | 85.7 | 370.07 | 14.1 | 230.18 | 120.1 |
| 257.92 | 76.2 | 376.31 | 8.6 | 233.73 | 108.6 |
| 262.55 | 69.8 | 384.63 | 6.0 | 238.46 | 94.2 |
| 267.18 | 60.3 | 415.89 | 9.7 | 244.38 | 82.7 |
| 271.81 | 50.8 | 400.28 | 14.9 | 250.30 | 74.1 |
| 276.45 | 44.4 | 391.93 | 9.0 | 256.21 | 65.5 |
| 283.40 | 31.7 | 426.31 | 10.0 | 262.13 | 56.8 |
| 290.35 | 22.2 | 435.69 | 13.1 | 268.05 | 48.2 |
| 298.46 | 9.5 | 448.19 | 10.6 | 276.33 | 39.6 |
| 311.20 | 6.3 | 459.65 | 10.9 | 282.25 | 36.7 |
| 316.99 | 6.3 | 471.10 | 11.3 | 291.72 | 33.8 |
| 329.73 | 0.0 | | | 297.63 | 30.9 |
| 340.15 | 6.3 | | | 303.55 | 28.1 |
| 352.90 | 6.3 | | | 310.65 | 19.4 |
| 362.16 | 0.0 | | | 316.57 | 10.8 |
| 364.48 | 0.0 | | | 323.67 | 7.9 |
| 378.38 | 6.3 | | | 330.77 | 2.2 |
| 386.49 | 6.3 | | | 337.87 | -0.7 |
| 408.49 | 6.3 | | | 344.97 | -3.6 |
| 415.44 | 9.5 | | | 353.25 | -0.7 |
| 421.24 | 6.3 | | | 359.17 | 2.2 |
| 430.50 | 6.3 | | | 365.09 | 5.0 |
| 439.77 | 9.5 | | | 375.74 | -3.6 |
| 445.56 | 6.3 | | | 385.21 | -3.6 |
| 395.75 | 0.0 | | | 389.94 | -3.6 |
| | | | | 398.22 | 2.2 |
| | | | | 415.98 | -3.6 |
| | | | | 430.18 | 2.2 |

# APPENDIX C

# RAW TGA AND DTG DATA USED IN SECTION 6

Table C-1: TGA and DTG for Linear and Cross-Linked PMMA

| Linear PMMA at 10C/min | | | Cross-Linked PMMA at 10C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 100.1540 | 100.000 | -0.000587 | 100.0510 | 100.000 | 0.002205 |
| 101.1420 | 99.996 | 0.025575 | 101.0330 | 100.000 | 0.001112 |
| 102.1270 | 99.980 | 0.005016 | 102.0280 | 99.997 | -0.003069 |
| 103.1210 | 99.973 | 0.029380 | 103.0170 | 99.992 | 0.000925 |
| 104.1110 | 99.955 | 0.014817 | 104.0110 | 99.992 | 0.018817 |
| 105.1080 | 99.943 | 0.004235 | 105.0000 | 99.974 | 0.017288 |
| 106.1070 | 99.938 | 0.005793 | 105.9900 | 99.959 | 0.022095 |
| 107.0940 | 99.933 | 0.010325 | 106.9840 | 99.942 | 0.031238 |
| 108.1020 | 99.916 | 0.012875 | 107.9800 | 99.917 | -0.012710 |
| 109.0990 | 99.899 | 0.019336 | 108.9660 | 99.908 | 0.014504 |
| 110.0970 | 99.887 | 0.012781 | 109.9590 | 99.905 | -0.020738 |
| 111.1090 | 99.873 | 0.013121 | 110.9520 | 99.914 | 0.001112 |
| 112.1040 | 99.861 | 0.012005 | 111.9490 | 99.908 | 0.016124 |
| 113.1210 | 99.845 | 0.023093 | 112.9440 | 99.885 | 0.029560 |
| 114.1220 | 99.824 | 0.012923 | 113.9380 | 99.867 | 0.020971 |
| 115.1270 | 99.808 | 0.014761 | 114.9420 | 99.846 | 0.021780 |
| 116.1440 | 99.792 | 0.019163 | 115.9270 | 99.824 | 0.011916 |
| 117.1580 | 99.780 | 0.007278 | 116.9250 | 99.825 | 0.003636 |
| 118.1720 | 99.778 | 0.010619 | 117.9240 | 99.815 | -0.000538 |
| 119.1860 | 99.758 | 0.022665 | 118.9190 | 99.805 | 0.021577 |
| 120.1970 | 99.734 | 0.012265 | 119.9180 | 99.794 | 0.007776 |
| 121.2000 | 99.731 | -0.001349 | 120.9200 | 99.773 | 0.033481 |
| 122.2020 | 99.729 | 0.015159 | 121.9290 | 99.742 | 0.029363 |
| 123.2240 | 99.717 | 0.003463 | 122.9250 | 99.722 | 0.009259 |
| 124.2230 | 99.716 | 0.006533 | 123.9350 | 99.710 | 0.015669 |
| 125.2310 | 99.708 | 0.011420 | 124.9400 | 99.691 | 0.016057 |
| 126.2280 | 99.696 | 0.007291 | 125.9440 | 99.679 | 0.007793 |
| 127.2410 | 99.683 | 0.007318 | 126.9480 | 99.671 | 0.023289 |
| 128.2550 | 99.686 | -0.022370 | 127.9550 | 99.638 | 0.041563 |
| 129.2600 | 99.692 | 0.002767 | 128.9620 | 99.606 | 0.010374 |
| 130.2620 | 99.677 | 0.024849 | 129.9710 | 99.589 | 0.013006 |
| 131.2760 | 99.669 | 0.001872 | 130.9740 | 99.571 | 0.022637 |
| 132.2860 | 99.669 | -0.006991 | 131.9860 | 99.553 | 0.014338 |
| 133.2860 | 99.671 | 0.000439 | 132.9850 | 99.529 | 0.026232 |
| 134.2960 | 99.668 | 0.005770 | 133.9920 | 99.504 | 0.021477 |
| 135.2980 | 99.661 | -0.002568 | 134.9970 | 99.474 | 0.047186 |
| 136.3040 | 99.663 | 0.005779 | 135.9940 | 99.443 | 0.030475 |
| 137.3350 | 99.652 | 0.008569 | 136.9910 | 99.411 | 0.033952 |
| 138.3350 | 99.644 | 0.000886 | 138.0060 | 99.393 | 0.014283 |
| 139.3380 | 99.649 | -0.005727 | 139.0090 | 99.370 | 0.025600 |
| 140.3600 | 99.655 | -0.004590 | 140.0170 | 99.342 | 0.021379 |
| 141.3560 | 99.649 | 0.012469 | 141.0260 | 99.320 | 0.022430 |
| 142.3760 | 99.638 | 0.009647 | 142.0290 | 99.286 | 0.042506 |
| 143.3880 | 99.636 | -0.008106 | 143.0430 | 99.243 | 0.035282 |
| 144.4010 | 99.642 | 0.000213 | 144.0440 | 99.216 | 0.023992 |
| 145.4010 | 99.629 | 0.014390 | 145.0450 | 99.193 | 0.025109 |
| 146.4160 | 99.627 | -0.004590 | 146.0570 | 99.170 | 0.026199 |
| 147.4320 | 99.633 | -0.010422 | 147.0620 | 99.140 | 0.032125 |
| 148.4400 | 99.633 | 0.012512 | 148.0690 | 99.113 | 0.029211 |
| 149.4520 | 99.619 | 0.006481 | 149.0780 | 99.077 | 0.036567 |
| 150.4760 | 99.612 | -0.003326 | 150.0970 | 99.042 | 0.034399 |
| 151.4960 | 99.619 | 0.001224 | 151.0970 | 99.013 | 0.021989 |
| 152.5030 | 99.619 | 0.012301 | 152.1100 | 98.993 | 0.022533 |
| 153.5270 | 99.603 | -0.005539 | 153.1130 | 98.966 | 0.027098 |
| 154.5480 | 99.609 | -0.000519 | 154.1290 | 98.939 | 0.011636 |
| 155.5590 | 99.607 | 0.002052 | 155.1330 | 98.923 | 0.024875 |
| 156.5860 | 99.597 | 0.010619 | 156.1440 | 98.885 | 0.058516 |

Table C-1: Continued

| Linear PMMA at 10C/min | | | Cross-Linked PMMA at 10C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 157.6000 | 99.589 | 0.004253 | 157.1590 | 98.854 | 0.029858 |
| 158.6170 | 99.590 | -0.008749 | 158.1670 | 98.833 | 0.014230 |
| 159.6370 | 99.592 | 0.005779 | 159.1720 | 98.800 | 0.021741 |
| 160.6600 | 99.582 | 0.018509 | 160.1830 | 98.787 | 0.010221 |
| 161.6840 | 99.564 | 0.015619 | 161.2070 | 98.769 | 0.032057 |
| 162.6900 | 99.558 | 0.001434 | 162.2120 | 98.740 | 0.003700 |
| 163.7210 | 99.561 | 0.001872 | 163.2270 | 98.725 | 0.017437 |
| 164.7420 | 99.555 | 0.008258 | 164.2390 | 98.701 | 0.022227 |
| 165.7600 | 99.537 | 0.022257 | 165.2500 | 98.678 | 0.023177 |
| 166.7910 | 99.526 | 0.001853 | 166.2680 | 98.661 | 0.006363 |
| 167.8010 | 99.519 | 0.009923 | 167.2800 | 98.642 | 0.019428 |
| 168.8180 | 99.502 | 0.025909 | 168.2880 | 98.628 | 0.011875 |
| 169.8510 | 99.483 | 0.005788 | 169.3040 | 98.616 | 0.022637 |
| 170.8750 | 99.483 | 0.002728 | 170.3110 | 98.587 | 0.038504 |
| 171.8970 | 99.470 | 0.027601 | 171.3330 | 98.557 | 0.017362 |
| 172.9200 | 99.443 | 0.021723 | 172.3450 | 98.542 | 0.014677 |
| 173.9490 | 99.427 | 0.007318 | 173.3450 | 98.528 | 0.018779 |
| 174.9770 | 99.424 | 0.004244 | 174.3650 | 98.511 | 0.009034 |
| 175.9940 | 99.410 | 0.023865 | 175.3900 | 98.501 | 0.014618 |
| 177.0110 | 99.379 | 0.020008 | 176.4020 | 98.486 | 0.021185 |
| 178.0400 | 99.363 | 0.015944 | 177.4200 | 98.457 | 0.024221 |
| 179.0720 | 99.348 | 0.007360 | 178.4330 | 98.442 | 0.021379 |
| 180.0880 | 99.328 | 0.020757 | 179.4530 | 98.429 | 0.011916 |
| 181.1170 | 99.305 | 0.025530 | 180.4630 | 98.400 | 0.024098 |
| 182.1380 | 99.287 | 0.010263 | 181.4830 | 98.384 | -0.017890 |
| 183.1590 | 99.275 | 0.017366 | 182.4970 | 98.387 | 0.014504 |
| 184.1790 | 99.251 | 0.030667 | 183.5140 | 98.369 | 0.018103 |
| 185.2120 | 99.219 | 0.026890 | 184.5400 | 98.332 | 0.022095 |
| 186.2360 | 99.189 | 0.019770 | 185.5560 | 98.319 | 0.020383 |
| 187.2610 | 99.170 | 0.022403 | 186.5580 | 98.300 | 0.022227 |
| 188.2860 | 99.140 | 0.033517 | 187.5760 | 98.275 | 0.010281 |
| 189.3100 | 99.100 | 0.034592 | 188.5920 | 98.275 | -0.000504 |
| 190.3330 | 99.076 | 0.018858 | 189.6130 | 98.260 | 0.031495 |
| 191.3570 | 99.055 | 0.026127 | 190.6330 | 98.239 | 0.022227 |
| 192.3850 | 99.014 | 0.036853 | 191.6350 | 98.220 | 0.007618 |
| 193.4100 | 98.984 | 0.028945 | 192.6590 | 98.203 | 0.013297 |
| 194.4350 | 98.961 | 0.022770 | 193.6760 | 98.187 | 0.025593 |
| 195.4560 | 98.929 | 0.036699 | 194.6940 | 98.172 | 0.003575 |
| 196.4810 | 98.885 | 0.049192 | 195.7040 | 98.168 | 0.012960 |
| 197.5000 | 98.839 | 0.034657 | 196.7230 | 98.147 | 0.020015 |
| 198.5260 | 98.810 | 0.027857 | 197.7350 | 98.132 | 0.019751 |
| 199.5660 | 98.776 | 0.040106 | 198.7490 | 98.118 | 0.022029 |
| 200.5830 | 98.734 | 0.034882 | 199.7720 | 98.093 | 0.023233 |
| 201.6030 | 98.695 | 0.045494 | 200.7800 | 98.076 | 0.011793 |
| 202.6250 | 98.654 | 0.034250 | 201.8080 | 98.063 | 0.018734 |
| 203.6490 | 98.609 | 0.045085 | 202.8270 | 98.050 | 0.010438 |
| 204.6840 | 98.553 | 0.066768 | 203.8380 | 98.035 | 0.019664 |
| 205.7130 | 98.500 | 0.040106 | 204.8600 | 98.016 | 0.016794 |
| 206.7360 | 98.460 | 0.039103 | 205.8840 | 97.998 | 0.023659 |
| 207.7730 | 98.412 | 0.061235 | 206.9010 | 97.976 | 0.017825 |
| 208.8000 | 98.347 | 0.055856 | 207.9130 | 97.960 | 0.024760 |
| 209.8270 | 98.284 | 0.050600 | 208.9400 | 97.940 | 0.002368 |
| 210.8490 | 98.239 | 0.049192 | 209.9600 | 97.932 | 0.006332 |
| 211.8830 | 98.184 | 0.060054 | 210.9910 | 97.923 | 0.014283 |
| 212.8980 | 98.117 | 0.054180 | 212.0070 | 97.900 | 0.015546 |
| 213.9360 | 98.064 | 0.052371 | 213.0260 | 97.883 | 0.019412 |
| 214.9690 | 97.999 | 0.071774 | 214.0500 | 97.870 | 0.008988 |
| 215.9950 | 97.922 | 0.075195 | 215.0770 | 97.853 | 0.029211 |
| 217.0280 | 97.847 | 0.066482 | 216.0940 | 97.832 | 0.018103 |
| 218.0590 | 97.783 | 0.059821 | 217.1280 | 97.824 | -0.010165 |
| 219.0770 | 97.717 | 0.067741 | 218.1380 | 97.813 | 0.031649 |
| 220.1180 | 97.630 | 0.093503 | 219.1630 | 97.781 | 0.013101 |
| 221.1500 | 97.542 | 0.081115 | 220.1870 | 97.769 | 0.018255 |
| 222.1710 | 97.462 | 0.076412 | 221.2130 | 97.744 | 0.017513 |
| 223.1990 | 97.380 | 0.081474 | 222.2250 | 97.716 | 0.032819 |

Table C-1: Continued

| Linear PMMA at 10C/min | | | Cross-Linked PMMA at 10C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 224.2310 | 97.292 | 0.086802 | 223.2580 | 97.697 | 0.011714 |
| 225.2630 | 97.200 | 0.089952 | 224.2790 | 97.689 | 0.010503 |
| 226.2900 | 97.109 | 0.095029 | 225.2980 | 97.666 | 0.025227 |
| 227.3200 | 97.012 | 0.103047 | 226.3240 | 97.644 | 0.018817 |
| 228.3390 | 96.899 | 0.103603 | 227.3350 | 97.626 | 0.016862 |
| 229.3710 | 96.795 | 0.107974 | 228.3540 | 97.600 | 0.022328 |
| 230.3980 | 96.699 | 0.086066 | 229.3860 | 97.578 | 0.021185 |
| 231.4320 | 96.605 | 0.103634 | 230.4070 | 97.554 | 0.028197 |
| 232.4540 | 96.491 | 0.127285 | 231.4180 | 97.531 | 0.025717 |
| 233.4890 | 96.369 | 0.113977 | 232.4500 | 97.501 | 0.032125 |
| 234.5140 | 96.255 | 0.112310 | 233.4700 | 97.478 | 0.022227 |
| 235.5380 | 96.143 | 0.111945 | 234.4900 | 97.454 | 0.037164 |
| 236.5680 | 96.023 | 0.124837 | 235.5030 | 97.418 | 0.034718 |
| 237.6030 | 95.899 | 0.120375 | 236.5380 | 97.388 | 0.025717 |
| 238.6230 | 95.785 | 0.116063 | 237.5580 | 97.354 | 0.035290 |
| 239.6510 | 95.658 | 0.120853 | 238.5770 | 97.321 | 0.036425 |
| 240.6940 | 95.526 | 0.135481 | 239.6110 | 97.288 | 0.035563 |
| 241.7180 | 95.397 | 0.126255 | 240.6300 | 97.249 | 0.044734 |
| 242.7430 | 95.270 | 0.120453 | 241.6430 | 97.208 | 0.033974 |
| 243.7760 | 95.146 | 0.122098 | 242.6720 | 97.166 | 0.060946 |
| 244.8050 | 95.012 | 0.143393 | 243.6840 | 97.111 | 0.054463 |
| 245.8340 | 94.873 | 0.134695 | 244.7050 | 97.058 | 0.037179 |
| 246.8600 | 94.738 | 0.123706 | 245.7320 | 97.017 | 0.043635 |
| 247.8870 | 94.604 | 0.137053 | 246.7640 | 96.961 | 0.073761 |
| 248.9140 | 94.469 | 0.134695 | 247.7740 | 96.904 | 0.055620 |
| 249.9400 | 94.330 | 0.127067 | 248.7910 | 96.841 | 0.062270 |
| 250.9650 | 94.205 | 0.125541 | 249.8120 | 96.764 | 0.084047 |
| 251.9940 | 94.071 | 0.138465 | 250.8350 | 96.681 | 0.084103 |
| 253.0240 | 93.922 | 0.136970 | 251.8580 | 96.610 | 0.075083 |
| 254.0410 | 93.786 | 0.129624 | 252.8720 | 96.524 | 0.084047 |
| 255.0680 | 93.649 | 0.124553 | 253.8930 | 96.439 | 0.086528 |
| 256.1020 | 93.515 | 0.135454 | 254.9280 | 96.343 | 0.098949 |
| 257.1270 | 93.374 | 0.136931 | 255.9360 | 96.243 | 0.114709 |
| 258.1560 | 93.232 | 0.132447 | 256.9500 | 96.116 | 0.111198 |
| 259.1830 | 93.094 | 0.131748 | 257.9840 | 96.005 | 0.114709 |
| 260.2110 | 92.950 | 0.146138 | 259.0050 | 95.880 | 0.124867 |
| 261.2430 | 92.799 | 0.154585 | 260.0240 | 95.747 | 0.136085 |
| 262.2680 | 92.653 | 0.128026 | 261.0400 | 95.608 | 0.133270 |
| 263.2940 | 92.515 | 0.138487 | 262.0530 | 95.465 | 0.137742 |
| 264.3190 | 92.370 | 0.146900 | 263.0780 | 95.310 | 0.167670 |
| 265.3410 | 92.211 | 0.154073 | 264.0960 | 95.147 | 0.155495 |
| 266.3710 | 92.048 | 0.154818 | 265.1110 | 94.977 | 0.165452 |
| 267.4000 | 91.896 | 0.154708 | 266.1330 | 94.789 | 0.199408 |
| 268.4290 | 91.746 | 0.153107 | 267.1450 | 94.609 | 0.169914 |
| 269.4520 | 91.590 | 0.158682 | 268.1690 | 94.427 | 0.193424 |
| 270.4670 | 91.429 | 0.142709 | 269.1870 | 94.219 | 0.201741 |
| 271.5080 | 91.274 | 0.157852 | 270.2070 | 94.009 | 0.219337 |
| 272.5260 | 91.107 | 0.174362 | 271.2250 | 93.791 | 0.214304 |
| 273.5440 | 90.934 | 0.157054 | 272.2470 | 93.556 | 0.251234 |
| 274.5690 | 90.773 | 0.150998 | 273.2570 | 93.309 | 0.246127 |
| 275.5990 | 90.616 | 0.164271 | 274.2800 | 93.057 | 0.246368 |
| 276.6120 | 90.438 | 0.164787 | 275.2950 | 92.801 | 0.263723 |
| 277.6410 | 90.258 | 0.168978 | 276.3160 | 92.524 | 0.283488 |
| 278.6710 | 90.087 | 0.172974 | 277.3250 | 92.233 | 0.284067 |
| 279.6860 | 89.918 | 0.158603 | 278.3500 | 91.925 | 0.313103 |
| 280.7200 | 89.739 | 0.179438 | 279.3620 | 91.595 | 0.336988 |
| 281.7470 | 89.558 | 0.171639 | 280.3770 | 91.253 | 0.328821 |
| 282.7690 | 89.381 | 0.167887 | 281.3910 | 90.904 | 0.345925 |
| 283.7930 | 89.204 | 0.182553 | 282.4110 | 90.532 | 0.355146 |
| 284.8170 | 89.017 | 0.184572 | 283.4240 | 90.161 | 0.377399 |
| 285.8330 | 88.838 | 0.161071 | 284.4460 | 89.766 | 0.389035 |
| 286.8590 | 88.666 | 0.168233 | 285.4590 | 89.347 | 0.434227 |
| 287.8820 | 88.486 | 0.182669 | 286.4770 | 88.921 | 0.446563 |
| 288.9060 | 88.296 | 0.182553 | 287.4880 | 88.470 | 0.440704 |
| 289.9250 | 88.113 | 0.172793 | 288.5050 | 88.008 | 0.443724 |
| 290.9580 | 87.936 | 0.181065 | 289.5160 | 87.533 | 0.455273 |

Table C-1: Continued

| Linear PMMA at 10C/min | | | Cross-Linked PMMA at 10C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 291.9720 | 87.756 | 0.177163 | 290.5360 | 87.044 | 0.480424 |
| 293.0100 | 87.566 | 0.185169 | 291.5530 | 86.546 | 0.516022 |
| 294.0260 | 87.388 | 0.173372 | 292.5650 | 86.023 | 0.522800 |
| 295.0500 | 87.206 | 0.178939 | 293.5820 | 85.485 | 0.573608 |
| 296.0750 | 87.015 | 0.213143 | 294.5980 | 84.933 | 0.559033 |
| 297.0860 | 86.820 | 0.191044 | 295.6060 | 84.378 | 0.538523 |
| 298.1080 | 86.633 | 0.175173 | 296.6230 | 83.807 | 0.578325 |
| 299.1320 | 86.451 | 0.173450 | 297.6410 | 83.213 | 0.567687 |
| 300.1490 | 86.269 | 0.174320 | 298.6570 | 82.617 | 0.614122 |
| 301.1850 | 86.071 | 0.201136 | 299.6640 | 82.010 | 0.623488 |
| 302.2010 | 85.877 | 0.188539 | 300.6790 | 81.373 | 0.595297 |
| 303.2250 | 85.685 | 0.197570 | 301.7000 | 80.735 | 0.665949 |
| 304.2420 | 85.488 | 0.184236 | 302.7070 | 80.084 | 0.631236 |
| 305.2630 | 85.292 | 0.189734 | 303.7250 | 79.429 | 0.666216 |
| 306.2820 | 85.096 | 0.187022 | 304.7350 | 78.761 | 0.661375 |
| 307.3020 | 84.902 | 0.194195 | 305.7570 | 78.079 | 0.672091 |
| 308.3250 | 84.694 | 0.214791 | 306.7730 | 77.379 | 0.731473 |
| 309.3530 | 84.477 | 0.208256 | 307.7860 | 76.666 | 0.711208 |
| 310.3710 | 84.273 | 0.206381 | 308.8000 | 75.951 | 0.701482 |
| 311.3890 | 84.068 | 0.209336 | 309.8150 | 75.223 | 0.736961 |
| 312.4030 | 83.845 | 0.219458 | 310.8230 | 74.474 | 0.714644 |
| 313.4250 | 83.610 | 0.211598 | 311.8420 | 73.736 | 0.703691 |
| 314.4440 | 83.380 | 0.235734 | 312.8640 | 72.976 | 0.802730 |
| 315.4660 | 83.145 | 0.254219 | 313.8680 | 72.200 | 0.779251 |
| 316.4810 | 82.895 | 0.252586 | 314.8860 | 71.419 | 0.795960 |
| 317.4970 | 82.646 | 0.247034 | 315.9000 | 70.619 | 0.811743 |
| 318.5330 | 82.386 | 0.276532 | 316.9110 | 69.817 | 0.774047 |
| 319.5400 | 82.109 | 0.303435 | 317.9330 | 69.008 | 0.801349 |
| 320.5510 | 81.815 | 0.282469 | 318.9360 | 68.192 | 0.812739 |
| 321.5710 | 81.524 | 0.291517 | 319.9520 | 67.358 | 0.855809 |
| 322.5800 | 81.221 | 0.295108 | 320.9690 | 66.521 | 0.813211 |
| 323.6020 | 80.910 | 0.315505 | 321.9850 | 65.663 | 0.893391 |
| 324.6200 | 80.568 | 0.350564 | 323.0020 | 64.785 | 0.937364 |
| 325.6380 | 80.225 | 0.327757 | 324.0080 | 63.906 | 0.890888 |
| 326.6530 | 79.871 | 0.363402 | 325.0220 | 63.020 | 0.910361 |
| 327.6670 | 79.495 | 0.388714 | 326.0370 | 62.118 | 0.893110 |
| 328.6700 | 79.098 | 0.385712 | 327.0500 | 61.206 | 0.897238 |
| 329.6990 | 78.689 | 0.408720 | 328.0650 | 60.265 | 0.959778 |
| 330.7050 | 78.257 | 0.462896 | 329.0750 | 59.303 | 0.968744 |
| 331.7090 | 77.795 | 0.452666 | 330.0890 | 58.332 | 0.968744 |
| 332.7360 | 77.307 | 0.493266 | 331.1070 | 57.339 | 1.020020 |
| 333.7480 | 76.814 | 0.492273 | 332.1180 | 56.319 | 1.021509 |
| 334.7540 | 76.294 | 0.554981 | 333.1310 | 55.310 | 1.060531 |
| 335.7720 | 75.726 | 0.569773 | 334.1340 | 54.281 | 1.025079 |
| 336.7790 | 75.134 | 0.609665 | 335.1460 | 53.209 | 1.021377 |
| 337.7860 | 74.516 | 0.614434 | 336.1590 | 52.118 | 1.085313 |
| 338.8000 | 73.867 | 0.702546 | 337.1760 | 51.015 | 1.090017 |
| 339.8080 | 73.156 | 0.718631 | 338.1940 | 49.895 | 1.147789 |
| 340.8150 | 72.394 | 0.806601 | 339.2030 | 48.766 | 1.132623 |
| 341.8230 | 71.553 | 0.837252 | 340.2140 | 47.635 | 1.121910 |
| 342.8310 | 70.680 | 0.948924 | 341.2250 | 46.495 | 1.136820 |
| 343.8440 | 69.731 | 0.975239 | 342.2480 | 45.343 | 1.197344 |
| 344.8460 | 68.763 | 1.007658 | 343.2560 | 44.188 | 1.112188 |
| 345.8510 | 67.760 | 1.050455 | 344.2690 | 43.026 | 1.151779 |
| 346.8580 | 66.721 | 1.091964 | 345.2810 | 41.870 | 1.130202 |
| 347.8640 | 65.610 | 1.184781 | 346.3000 | 40.732 | 1.113778 |
| 348.8640 | 64.402 | 1.254365 | 347.3150 | 39.598 | 1.135367 |
| 349.8700 | 63.185 | 1.233063 | 348.3250 | 38.478 | 1.107715 |
| 350.8710 | 61.942 | 1.298627 | 349.3370 | 37.395 | 1.096388 |
| 351.8760 | 60.647 | 1.329932 | 350.3540 | 36.314 | 1.103331 |
| 352.8720 | 59.303 | 1.310804 | 351.3630 | 35.249 | 1.037150 |
| 353.8780 | 57.911 | 1.459334 | 352.3750 | 34.210 | 0.998075 |
| 354.8810 | 56.471 | 1.469443 | 353.3930 | 33.200 | 1.001275 |
| 355.8860 | 55.012 | 1.493203 | 354.4180 | 32.202 | 1.017089 |
| 356.8870 | 53.508 | 1.546052 | 355.4310 | 31.236 | 0.921208 |
| 357.8880 | 51.982 | 1.505808 | 356.4440 | 30.301 | 0.902565 |

Table C-1: Continued

| Linear PMMA at 10C/min | | | Cross-Linked PMMA at 10C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 358.8940 | 50.419 | 1.528748 | 357.4630 | 29.392 | 0.888610 |
| 359.8980 | 48.822 | 1.699003 | 358.4720 | 28.515 | 0.853293 |
| 360.9020 | 47.187 | 1.646319 | 359.4860 | 27.658 | 0.835035 |
| 361.9080 | 45.547 | 1.603886 | 360.5070 | 26.819 | 0.799344 |
| 362.9060 | 43.908 | 1.576819 | 361.5190 | 26.026 | 0.809802 |
| 363.9140 | 42.248 | 1.660563 | 362.5300 | 25.247 | 0.759159 |
| 364.9290 | 40.574 | 1.678423 | 363.5490 | 24.493 | 0.733978 |
| 365.9410 | 38.902 | 1.686845 | 364.5630 | 23.770 | 0.716278 |
| 366.9440 | 37.233 | 1.702636 | 365.5810 | 23.085 | 0.666733 |
| 367.9520 | 35.545 | 1.663223 | 366.5940 | 22.408 | 0.680175 |
| 368.9660 | 33.847 | 1.742560 | 367.6060 | 21.746 | 0.609188 |
| 369.9750 | 32.154 | 1.661515 | 368.6260 | 21.122 | 0.613951 |
| 370.9830 | 30.463 | 1.659754 | 369.6370 | 20.511 | 0.596948 |
| 372.0010 | 28.744 | 1.690089 | 370.6410 | 19.909 | 0.542099 |
| 373.0260 | 27.050 | 1.683730 | 371.6600 | 19.340 | 0.531054 |
| 374.0580 | 25.426 | 1.586318 | 372.6780 | 18.800 | 0.526866 |
| 375.0740 | 23.843 | 1.626007 | 373.6890 | 18.278 | 0.495738 |
| 376.0830 | 22.227 | 1.661161 | 374.7100 | 17.778 | 0.490362 |
| 377.0960 | 20.590 | 1.517696 | 375.7220 | 17.287 | 0.482941 |
| 378.1190 | 19.014 | 1.508533 | 376.7290 | 16.811 | 0.449580 |
| 379.1370 | 17.504 | 1.401279 | 377.7410 | 16.349 | 0.438485 |
| 380.1650 | 16.057 | 1.362125 | 378.7590 | 15.897 | 0.445313 |
| 381.1950 | 14.696 | 1.284468 | 379.7690 | 15.470 | 0.388115 |
| 382.2130 | 13.409 | 1.208531 | 380.7850 | 15.066 | 0.390148 |
| 383.2440 | 12.217 | 1.114076 | 381.7940 | 14.660 | 0.403384 |
| 384.2710 | 11.105 | 1.004060 | 382.8090 | 14.272 | 0.364808 |
| 385.3080 | 10.093 | 0.980793 | 383.8230 | 13.903 | 0.366756 |
| 386.3270 | 9.166 | 0.836275 | 384.8360 | 13.540 | 0.358309 |
| 387.3590 | 8.309 | 0.798234 | 385.8460 | 13.178 | 0.345117 |
| 388.3930 | 7.508 | 0.723693 | 386.8520 | 12.844 | 0.314450 |
| 389.4180 | 6.797 | 0.633445 | 387.8670 | 12.521 | 0.328817 |
| 390.4490 | 6.157 | 0.619224 | 388.8760 | 12.206 | 0.311308 |
| 391.4680 | 5.566 | 0.523078 | 389.8880 | 11.907 | 0.307769 |
| 392.5060 | 5.043 | 0.492703 | 390.9070 | 11.603 | 0.291076 |
| 393.5280 | 4.566 | 0.402869 | 391.9020 | 11.315 | 0.274242 |
| 394.5470 | 4.141 | 0.398249 | 392.9210 | 11.045 | 0.258334 |
| 395.5780 | 3.753 | 0.339831 | 393.9280 | 10.774 | 0.258451 |
| 396.5940 | 3.413 | 0.299668 | 394.9410 | 10.518 | 0.254834 |
| 397.6180 | 3.118 | 0.258425 | 395.9520 | 10.272 | 0.233003 |
| 398.6410 | 2.851 | 0.257514 | 396.9560 | 10.044 | 0.217764 |
| 399.6680 | 2.598 | 0.218397 | 397.9780 | 9.809 | 0.232193 |
| 400.6820 | 2.388 | 0.193468 | 398.9840 | 9.581 | 0.207313 |
| 401.6980 | 2.199 | 0.175083 | 399.9920 | 9.365 | 0.213363 |
| 402.7120 | 2.022 | 0.165926 | 401.0000 | 9.148 | 0.187965 |
| 403.7340 | 1.867 | 0.128745 | 402.0090 | 8.947 | 0.185221 |
| 404.7480 | 1.736 | 0.121250 | 403.0180 | 8.776 | 0.177112 |
| 405.7660 | 1.626 | 0.111825 | 404.0350 | 8.593 | 0.192402 |
| 406.7700 | 1.519 | 0.103790 | 405.0410 | 8.409 | 0.159974 |
| 407.7840 | 1.416 | 0.089042 | 406.0480 | 8.246 | 0.160822 |
| 408.7990 | 1.341 | 0.058566 | 407.0600 | 8.077 | 0.181053 |
| 409.8160 | 1.281 | 0.059314 | 408.0660 | 7.915 | 0.152083 |
| 410.8290 | 1.218 | 0.064881 | 409.0760 | 7.769 | 0.148620 |
| 411.8460 | 1.166 | 0.048447 | 410.0800 | 7.628 | 0.137850 |
| 412.8460 | 1.119 | 0.040909 | 411.0840 | 7.499 | 0.129915 |
| 413.8520 | 1.076 | 0.041772 | 412.0970 | 7.373 | 0.131709 |
| 414.8680 | 1.042 | 0.025935 | 413.1000 | 7.241 | 0.137282 |
| 415.8800 | 1.016 | 0.019870 | 414.1030 | 7.115 | 0.102123 |
| 416.8820 | 1.003 | 0.020040 | 415.1150 | 7.009 | 0.114872 |
| 417.8860 | 0.978 | 0.028019 | 416.1150 | 6.897 | 0.130121 |
| 418.8990 | 0.949 | 0.021437 | 417.1190 | 6.775 | 0.089271 |
| 419.9050 | 0.937 | 0.005623 | 418.1270 | 6.699 | 0.080307 |
| 420.9080 | 0.927 | 0.019212 | 419.1380 | 6.612 | 0.097466 |
| 421.9170 | 0.911 | 0.012459 | 420.1510 | 6.516 | 0.100941 |
| 422.9220 | 0.902 | 0.006588 | 421.1470 | 6.429 | 0.085054 |
| 423.9320 | 0.887 | 0.015668 | 422.1500 | 6.346 | 0.080472 |
| 424.9300 | 0.878 | -0.001660 | 423.1550 | 6.265 | 0.090011 |

Table C-1: Continued

| Linear PMMA at 10C/min | | | Cross-Linked PMMA at 10C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 425.9430 | 0.876 | 0.005166 | 424.1550 | 6.187 | 0.055439 |
| 426.9510 | 0.877 | -0.017951 | 425.1650 | 6.124 | 0.065188 |
| 427.9590 | 0.876 | 0.009597 | 426.1700 | 6.064 | 0.052398 |
| 428.9670 | 0.862 | 0.021012 | 427.1780 | 6.006 | 0.061873 |
| 429.9730 | 0.853 | -0.003974 | 428.1740 | 5.940 | 0.085827 |
| 430.9890 | 0.859 | 0.006144 | 429.1740 | 5.874 | 0.048148 |
| 431.9900 | 0.855 | -0.001025 | 430.1830 | 5.829 | 0.051502 |
| 432.9920 | 0.858 | 0.005544 | 431.1830 | 5.772 | 0.063666 |
| 434.0010 | 0.857 | -0.003925 | 432.1850 | 5.716 | 0.018788 |
| 435.0020 | 0.856 | 0.001179 | 433.1910 | 5.676 | 0.050973 |
| 436.0130 | 0.850 | 0.005332 | 434.1910 | 5.622 | 0.047404 |
| 437.0220 | 0.846 | 0.001008 | 435.1930 | 5.565 | 0.050023 |
| 438.0300 | 0.849 | 0.001754 | 436.2060 | 5.522 | 0.040701 |
| 439.0330 | 0.849 | -0.002030 | 437.2140 | 5.484 | 0.041844 |
| 440.0370 | 0.853 | 0.004714 | 438.2150 | 5.436 | 0.042562 |
| 441.0450 | 0.840 | 0.004863 | 439.2200 | 5.393 | 0.046059 |
| 442.0560 | 0.844 | -0.005580 | 440.2210 | 5.339 | 0.052970 |
| 443.0620 | 0.855 | -0.009804 | 441.2280 | 5.281 | 0.054611 |
| 444.0680 | 0.861 | 0.004553 | 442.2230 | 5.229 | 0.041609 |
| 445.0700 | 0.853 | 0.008989 | 443.2350 | 5.173 | 0.056614 |
| 446.0780 | 0.846 | 0.003033 | 444.2430 | 5.122 | 0.044073 |
| 447.0890 | 0.848 | -0.009620 | 445.2350 | 5.076 | 0.048828 |
| 448.1010 | 0.850 | 0.018957 | 446.2490 | 5.016 | 0.068587 |
| 449.1000 | 0.849 | -0.001468 | 447.2620 | 4.939 | 0.069490 |
| 450.1060 | 0.852 | -0.009020 | 448.2610 | 4.877 | 0.053422 |
| 451.1110 | 0.856 | 0.001755 | 449.2630 | 4.807 | 0.093603 |
| 452.1270 | 0.847 | 0.019185 | 450.2710 | 4.721 | 0.063854 |
| 453.1310 | 0.837 | -0.000497 | 451.2830 | 4.659 | 0.075449 |
| 454.1360 | 0.844 | -0.015066 | 452.2800 | 4.590 | 0.075552 |
| 455.1480 | 0.851 | 0.003601 | 453.2860 | 4.515 | 0.062607 |
| 456.1560 | 0.846 | 0.005774 | 454.2910 | 4.458 | 0.058281 |
| 457.1560 | 0.834 | 0.007255 | 455.3070 | 4.398 | 0.057224 |
| 458.1650 | 0.838 | -0.013368 | 456.3090 | 4.332 | 0.074013 |
| 459.1720 | 0.844 | -0.001619 | 457.3160 | 4.262 | 0.050994 |
| 460.1820 | 0.850 | -0.007564 | 458.3190 | 4.203 | 0.066649 |
| 461.1890 | 0.851 | -0.001114 | 459.3180 | 4.138 | 0.062347 |
| 462.1940 | 0.853 | 0.000202 | 460.3220 | 4.082 | 0.048255 |
| 463.1980 | 0.848 | 0.006551 | 461.3260 | 4.030 | 0.067605 |
| 464.2040 | 0.847 | -0.004354 | 462.3370 | 3.977 | 0.058734 |
| 465.2180 | 0.853 | -0.007236 | 463.3440 | 3.921 | 0.062929 |
| 466.2230 | 0.857 | -0.000452 | 464.3400 | 3.868 | 0.055974 |
| 467.2230 | 0.852 | 0.005774 | 465.3460 | 3.814 | 0.054812 |
| 468.2360 | 0.848 | -0.000899 | 466.3470 | 3.756 | 0.054332 |
| 469.2410 | 0.854 | -0.000843 | 467.3520 | 3.714 | 0.034836 |
| 470.2420 | 0.857 | -0.002612 | 468.3520 | 3.686 | 0.039107 |
| 471.2470 | 0.855 | 0.002893 | 469.3670 | 3.636 | 0.045251 |
| 472.2490 | 0.855 | 0.001171 | 470.3640 | 3.594 | 0.042141 |
| 473.2630 | 0.851 | 0.004783 | 471.3640 | 3.549 | 0.059452 |
| 474.2640 | 0.847 | 0.002968 | 472.3730 | 3.491 | 0.042497 |
| 475.2780 | 0.843 | -0.004202 | 473.3790 | 3.454 | 0.033924 |
| 476.2830 | 0.854 | -0.011194 | 474.3870 | 3.425 | 0.026642 |
| 477.2890 | 0.863 | 0.000342 | 475.3830 | 3.396 | 0.029996 |
| 478.3010 | 0.856 | 0.005580 | 476.3890 | 3.372 | 0.025383 |
| 479.3010 | 0.852 | -0.000781 | 477.3850 | 3.345 | 0.022492 |
| 480.3110 | 0.861 | -0.007795 | 478.3890 | 3.313 | 0.040682 |
| 481.3170 | 0.864 | 0.003395 | 479.3950 | 3.288 | 0.024150 |
| 482.3240 | 0.858 | 0.006137 | 480.3960 | 3.265 | 0.014393 |
| 483.3230 | 0.856 | -0.006587 | 481.4010 | 3.243 | 0.021014 |
| 484.3360 | 0.858 | -0.000850 | 482.3980 | 3.220 | 0.028057 |
| 485.3400 | 0.860 | -0.003890 | 483.3970 | 3.202 | 0.018322 |
| 486.3440 | 0.853 | 0.008122 | 484.3990 | 3.176 | 0.031975 |
| 487.3540 | 0.853 | -0.002002 | 485.4010 | 3.152 | 0.016402 |
| 488.3540 | 0.860 | -0.005190 | 486.4150 | 3.140 | 0.015980 |
| 489.3600 | 0.856 | 0.017909 | 487.4130 | 3.122 | 0.013795 |
| 490.3680 | 0.839 | 0.005242 | 488.4120 | 3.104 | 0.024284 |
| 491.3730 | 0.848 | -0.018864 | 489.4130 | 3.094 | 0.011916 |

Table C-1: Continued

| Linear PMMA at 10C/min | | | Cross-Linked PMMA at 10C/min | | |
|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 492.3740 | 0.859 | -0.004204 | 490.4070 | 3.081 | 0.021577 |
| 493.3770 | 0.857 | 0.003009 | 491.4070 | 3.054 | 0.035195 |
| 494.3870 | 0.859 | -0.005594 | 492.4110 | 3.031 | 0.010240 |
| 495.3860 | 0.859 | -0.003108 | 493.4170 | 3.019 | 0.015765 |
| 496.3960 | 0.862 | 0.000402 | 494.4240 | 3.015 | 0.018110 |
| 497.4030 | 0.861 | 0.003749 | 495.4200 | 2.997 | 0.009704 |
| 498.4050 | 0.854 | -0.000062 | 496.4350 | 2.985 | 0.015353 |
| 499.4100 | 0.860 | -0.010747 | 497.4250 | 2.968 | 0.022061 |
| 500.4140 | 0.867 | -0.002394 | 498.4340 | 2.945 | 0.022461 |
| 501.4250 | 0.869 | 0.015375 | 499.4330 | 2.928 | 0.003789 |
| 502.4260 | 0.850 | 0.010689 | 500.4320 | 2.928 | -0.000015 |
| 503.4320 | 0.850 | -0.004767 | 501.4380 | 2.919 | 0.024707 |
| 504.4410 | 0.859 | -0.011919 | 502.4400 | 2.905 | 0.017143 |
| 505.4540 | 0.869 | -0.002496 | 503.4440 | 2.886 | 0.009876 |

Table C-2: TGA and DTG for 1wt%, 3wt%, and 5wt% MMT in Cross-Linked PMMA

| 1wt% MMT in Cross-Linked PMMA (10C/min) | | | 3wt% MMT in Cross-Linked PMMA (10C/min) | | | 5wt% MMT in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 100.0430 | 100.000 | 0.006174 | 100.1620 | 100.000 | 0.013523 | 100.1160 | 100.000 | -0.004942 |
| 101.0470 | 99.997 | -0.005865 | 101.1560 | 99.992 | 0.000012 | 101.0920 | 100.004 | -0.003978 |
| 102.0340 | 99.998 | 0.002205 | 102.1350 | 99.994 | 0.002447 | 102.0820 | 100.009 | 0.003725 |
| 103.0290 | 99.998 | -0.003535 | 103.1420 | 99.991 | 0.001328 | 103.0540 | 100.000 | 0.015794 |
| 104.0110 | 100.005 | -0.001470 | 104.1300 | 99.989 | 0.012283 | 104.0500 | 99.989 | 0.001422 |
| 105.0160 | 100.006 | 0.001525 | 105.1210 | 99.982 | -0.004985 | 105.0270 | 99.993 | -0.013288 |
| 106.0080 | 100.004 | 0.004352 | 106.1130 | 99.987 | -0.003239 | 106.0130 | 99.999 | 0.023855 |
| 106.9970 | 100.003 | -0.000098 | 107.1020 | 99.986 | 0.001214 | 107.0110 | 99.986 | -0.004047 |
| 107.9970 | 100.005 | 0.003745 | 108.1020 | 99.981 | 0.006782 | 107.9910 | 99.997 | -0.005693 |
| 108.9880 | 100.002 | 0.000048 | 109.0930 | 99.979 | -0.002788 | 108.9800 | 100.007 | -0.007636 |
| 109.9820 | 100.003 | 0.003168 | 110.0940 | 99.979 | 0.002649 | 109.9630 | 100.006 | 0.015288 |
| 110.9880 | 100.000 | -0.001757 | 111.0890 | 99.972 | 0.008142 | 110.9510 | 99.999 | 0.002735 |
| 111.9790 | 100.004 | -0.006257 | 112.0860 | 99.963 | 0.005219 | 111.9470 | 99.994 | 0.007187 |
| 112.9770 | 100.005 | 0.007836 | 113.0860 | 99.962 | 0.003138 | 112.9390 | 99.994 | -0.003806 |
| 113.9670 | 99.999 | -0.005966 | 114.0810 | 99.964 | -0.001936 | 113.9330 | 99.997 | -0.002763 |
| 114.9760 | 99.997 | 0.004423 | 115.0850 | 99.958 | 0.006196 | 114.9350 | 100.000 | 0.006453 |
| 115.9860 | 99.991 | 0.005755 | 116.0850 | 99.950 | 0.015135 | 115.9300 | 99.995 | -0.003945 |
| 116.9800 | 99.987 | 0.001228 | 117.0890 | 99.944 | 0.001144 | 116.9240 | 99.995 | -0.001858 |
| 117.9880 | 99.987 | -0.009121 | 118.0890 | 99.948 | -0.001818 | 117.9230 | 99.987 | 0.017858 |
| 118.9920 | 99.990 | 0.003777 | 119.0960 | 99.937 | 0.013904 | 118.9350 | 99.972 | 0.005819 |
| 119.9870 | 99.984 | -0.003957 | 120.1020 | 99.924 | 0.009450 | 119.9310 | 99.971 | -0.013762 |
| 120.9870 | 99.987 | 0.008905 | 121.1040 | 99.918 | 0.006348 | 120.9330 | 99.986 | -0.004232 |
| 121.9970 | 99.975 | 0.009094 | 122.1050 | 99.914 | 0.003402 | 121.9290 | 99.976 | 0.011826 |
| 123.0060 | 99.971 | 0.002231 | 123.1130 | 99.899 | 0.019440 | 122.9370 | 99.956 | 0.010049 |
| 124.0160 | 99.968 | 0.010004 | 124.1230 | 99.891 | -0.019587 | 123.9430 | 99.954 | -0.001481 |
| 125.0180 | 99.961 | 0.009848 | 125.1250 | 99.894 | 0.011552 | 124.9540 | 99.962 | 0.001816 |
| 126.0310 | 99.947 | 0.010505 | 126.1430 | 99.880 | 0.017011 | 125.9630 | 99.958 | 0.004905 |
| 127.0530 | 99.940 | 0.001722 | 127.1580 | 99.864 | 0.014398 | 126.9660 | 99.950 | 0.009738 |
| 128.0550 | 99.934 | 0.019142 | 128.1630 | 99.859 | 0.000293 | 127.9740 | 99.946 | 0.003861 |
| 129.0800 | 99.928 | -0.003085 | 129.1790 | 99.853 | 0.011283 | 128.9930 | 99.942 | -0.000806 |
| 130.0870 | 99.921 | 0.012372 | 130.2040 | 99.841 | 0.014946 | 130.0040 | 99.939 | 0.004836 |
| 131.1120 | 99.909 | 0.005242 | 131.2200 | 99.825 | 0.015982 | 131.0210 | 99.926 | 0.015850 |
| 132.1260 | 99.897 | 0.013536 | 132.2400 | 99.814 | 0.007685 | 132.0300 | 99.919 | 0.003936 |
| 133.1550 | 99.885 | 0.003148 | 133.2660 | 99.804 | 0.017113 | 133.0460 | 99.921 | -0.003897 |
| 134.1750 | 99.880 | 0.015153 | 134.2870 | 99.785 | 0.017723 | 134.0630 | 99.924 | 0.004585 |
| 135.2040 | 99.863 | 0.004598 | 135.3070 | 99.772 | 0.007410 | 135.0780 | 99.904 | 0.039049 |
| 136.2360 | 99.858 | 0.009890 | 136.3150 | 99.765 | 0.008522 | 136.0800 | 99.888 | -0.003708 |
| 137.2460 | 99.847 | 0.005565 | 137.3430 | 99.748 | 0.014618 | 137.1030 | 99.897 | 0.000242 |
| 138.2780 | 99.844 | 0.007203 | 138.3670 | 99.737 | 0.011306 | 138.1010 | 99.894 | 0.013577 |
| 139.2920 | 99.835 | 0.004183 | 139.3840 | 99.726 | 0.010278 | 139.1260 | 99.879 | -0.006305 |
| 140.3050 | 99.837 | 0.007550 | 140.3950 | 99.717 | 0.010773 | 140.1390 | 99.883 | -0.002821 |
| 141.3290 | 99.823 | 0.014605 | 141.4160 | 99.707 | 0.011270 | 141.1530 | 99.885 | -0.002412 |
| 142.3360 | 99.820 | 0.003972 | 142.4370 | 99.694 | 0.004656 | 142.1700 | 99.882 | 0.006527 |
| 143.3520 | 99.812 | 0.014774 | 143.4400 | 99.694 | 0.003154 | 143.1810 | 99.870 | 0.019450 |
| 144.3690 | 99.807 | -0.001283 | 144.4530 | 99.686 | 0.013909 | 144.1870 | 99.861 | -0.000097 |
| 145.3750 | 99.803 | 0.018708 | 145.4780 | 99.671 | 0.012387 | 145.2040 | 99.865 | -0.006114 |
| 146.3850 | 99.798 | -0.000202 | 146.4940 | 99.661 | 0.003937 | 146.2190 | 99.866 | 0.005858 |
| 147.4020 | 99.796 | 0.006793 | 147.4990 | 99.660 | 0.005814 | 147.2220 | 99.855 | 0.013232 |
| 148.4120 | 99.793 | -0.001343 | 148.5110 | 99.651 | 0.009876 | 148.2430 | 99.844 | 0.013714 |
| 149.4180 | 99.791 | 0.010703 | 149.5230 | 99.643 | 0.003602 | 149.2580 | 99.836 | -0.001711 |
| 150.4520 | 99.786 | -0.002343 | 150.5360 | 99.634 | 0.007125 | 150.2710 | 99.837 | 0.007704 |
| 151.4700 | 99.783 | 0.015866 | 151.5570 | 99.633 | 0.000076 | 151.2980 | 99.830 | 0.002948 |
| 152.4770 | 99.778 | -0.003530 | 152.5710 | 99.622 | 0.004131 | 152.3070 | 99.825 | -0.000590 |
| 153.4900 | 99.779 | -0.000230 | 153.5850 | 99.618 | 0.007479 | 153.3310 | 99.832 | -0.001376 |
| 154.5150 | 99.776 | 0.002456 | 154.6050 | 99.611 | -0.001936 | 154.3410 | 99.824 | 0.017594 |
| 155.5300 | 99.774 | 0.005881 | 155.6270 | 99.611 | 0.006480 | 155.3680 | 99.810 | 0.008275 |
| 156.5520 | 99.773 | -0.001341 | 156.6340 | 99.602 | 0.002134 | 156.3790 | 99.806 | 0.002624 |
| 157.5640 | 99.771 | 0.004349 | 157.6550 | 99.599 | 0.007208 | 157.4010 | 99.808 | -0.001085 |
| 158.5800 | 99.771 | 0.001563 | 158.6770 | 99.589 | 0.006045 | 158.4220 | 99.810 | -0.003717 |
| 159.6020 | 99.769 | 0.002894 | 159.6930 | 99.588 | 0.005011 | 159.4450 | 99.799 | 0.012128 |
| 160.6160 | 99.764 | 0.006309 | 160.7150 | 99.575 | 0.010520 | 160.4610 | 99.787 | 0.013305 |
| 161.6440 | 99.764 | -0.003951 | 161.7370 | 99.574 | -0.003545 | 161.4780 | 99.769 | 0.008474 |
| 162.6680 | 99.765 | 0.004899 | 162.7540 | 99.570 | 0.005379 | 162.4950 | 99.770 | -0.015271 |
| 163.6840 | 99.760 | 0.005170 | 163.7730 | 99.565 | 0.007777 | 163.5170 | 99.780 | 0.004093 |
| 164.7100 | 99.762 | -0.002127 | 164.7890 | 99.556 | 0.005504 | 164.5400 | 99.770 | 0.003080 |
| 165.7180 | 99.762 | 0.003788 | 165.8120 | 99.556 | -0.004128 | 165.5550 | 99.766 | 0.002003 |

Table C-2: Continued

| 1wt% MMT in Cross-Linked PMMA (10C/min) | | | 3wt% MMT in Cross-Linked PMMA (10C/min) | | | 5wt% MMT in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 166.7460 | 99.757 | 0.000130 | 166.8340 | 99.552 | 0.006257 | 166.5810 | 99.765 | 0.005824 |
| 167.7600 | 99.759 | 0.000900 | 167.8500 | 99.549 | 0.002680 | 167.6070 | 99.753 | 0.009661 |
| 168.7830 | 99.754 | 0.002529 | 168.8750 | 99.544 | 0.011335 | 168.6260 | 99.744 | 0.005529 |
| 169.8050 | 99.751 | -0.000679 | 169.8990 | 99.537 | 0.002794 | 169.6410 | 99.749 | -0.009946 |
| 170.8280 | 99.752 | -0.001465 | 170.9150 | 99.530 | 0.019329 | 170.6660 | 99.754 | 0.010161 |
| 171.8440 | 99.750 | -0.001536 | 171.9450 | 99.523 | 0.000641 | 171.6830 | 99.736 | 0.010945 |
| 172.8700 | 99.751 | -0.004463 | 172.9620 | 99.518 | 0.016239 | 172.7030 | 99.727 | 0.013995 |
| 173.8970 | 99.751 | 0.004644 | 173.9810 | 99.513 | 0.000141 | 173.7340 | 99.719 | 0.001685 |
| 174.9210 | 99.745 | -0.001677 | 175.0050 | 99.511 | 0.005159 | 174.7520 | 99.721 | -0.001953 |
| 175.9370 | 99.744 | 0.001667 | 176.0290 | 99.507 | 0.000856 | 175.7810 | 99.716 | 0.013483 |
| 176.9580 | 99.740 | 0.003313 | 177.0530 | 99.503 | 0.011710 | 176.8070 | 99.708 | 0.000954 |
| 177.9840 | 99.740 | -0.002580 | 178.0780 | 99.500 | -0.001550 | 177.8290 | 99.706 | 0.001311 |
| 179.0060 | 99.741 | 0.007651 | 179.0920 | 99.497 | 0.021322 | 178.8520 | 99.709 | 0.004715 |
| 180.0370 | 99.733 | 0.005728 | 180.1240 | 99.484 | 0.003456 | 179.8720 | 99.699 | 0.010269 |
| 181.0520 | 99.735 | -0.002824 | 181.1460 | 99.481 | 0.005922 | 180.9050 | 99.689 | 0.013944 |
| 182.0820 | 99.735 | 0.004734 | 182.1680 | 99.475 | 0.005961 | 181.9220 | 99.690 | -0.010915 |
| 183.0980 | 99.734 | 0.001755 | 183.1910 | 99.466 | 0.013001 | 182.9530 | 99.693 | 0.005157 |
| 184.1270 | 99.733 | 0.007952 | 184.2130 | 99.458 | 0.003450 | 183.9630 | 99.679 | 0.013389 |
| 185.1480 | 99.728 | 0.003058 | 185.2410 | 99.453 | -0.000642 | 184.9950 | 99.665 | 0.013068 |
| 186.1680 | 99.727 | 0.007919 | 186.2520 | 99.456 | 0.002587 | 186.0180 | 99.656 | -0.012693 |
| 187.2040 | 99.722 | 0.007172 | 187.2820 | 99.447 | 0.015062 | 187.0360 | 99.662 | -0.000569 |
| 188.2170 | 99.718 | 0.002193 | 188.3130 | 99.435 | 0.003406 | 188.0620 | 99.656 | 0.020560 |
| 189.2450 | 99.716 | 0.003131 | 189.3330 | 99.433 | 0.003293 | 189.0950 | 99.639 | 0.003401 |
| 190.2750 | 99.715 | -0.003436 | 190.3590 | 99.428 | 0.005179 | 190.1160 | 99.638 | 0.010548 |
| 191.2930 | 99.718 | -0.001224 | 191.3740 | 99.417 | 0.019078 | 191.1400 | 99.638 | 0.000976 |
| 192.3180 | 99.713 | 0.003864 | 192.4050 | 99.403 | 0.003268 | 192.1670 | 99.633 | 0.013860 |
| 193.3460 | 99.711 | -0.000699 | 193.4290 | 99.404 | -0.003277 | 193.1820 | 99.617 | 0.016066 |
| 194.3640 | 99.704 | 0.005123 | 194.4510 | 99.399 | 0.005378 | 194.2120 | 99.610 | -0.009496 |
| 195.3900 | 99.704 | -0.004032 | 195.4770 | 99.396 | 0.008125 | 195.2320 | 99.618 | -0.004514 |
| 196.4180 | 99.701 | 0.012009 | 196.5040 | 99.385 | 0.008012 | 196.2660 | 99.614 | 0.021835 |
| 197.4460 | 99.695 | 0.003356 | 197.5140 | 99.384 | 0.001444 | 197.2770 | 99.598 | 0.016583 |
| 198.4670 | 99.692 | 0.001781 | 198.5560 | 99.377 | 0.009628 | 198.3060 | 99.583 | -0.002165 |
| 199.4920 | 99.689 | 0.001685 | 199.5800 | 99.368 | 0.015612 | 199.3350 | 99.581 | 0.010574 |
| 200.5230 | 99.688 | 0.004147 | 200.6020 | 99.352 | 0.001579 | 200.3570 | 99.571 | 0.006082 |
| 201.5470 | 99.681 | 0.006285 | 201.6310 | 99.350 | 0.010451 | 201.3880 | 99.564 | 0.002934 |
| 202.5760 | 99.679 | 0.000049 | 202.6520 | 99.336 | 0.004711 | 202.4200 | 99.565 | 0.000912 |
| 203.5950 | 99.677 | 0.002487 | 203.6730 | 99.333 | 0.002805 | 203.4380 | 99.561 | 0.009308 |
| 204.6250 | 99.674 | 0.006999 | 204.7070 | 99.325 | 0.010028 | 204.4670 | 99.551 | 0.008770 |
| 205.6580 | 99.667 | 0.006623 | 205.7350 | 99.321 | 0.005839 | 205.4890 | 99.540 | 0.021364 |
| 206.6820 | 99.663 | 0.003537 | 206.7610 | 99.310 | 0.014575 | 206.5210 | 99.526 | -0.000422 |
| 207.7160 | 99.655 | 0.007627 | 207.7880 | 99.301 | 0.006643 | 207.5510 | 99.532 | 0.001156 |
| 208.7450 | 99.648 | 0.006462 | 208.8200 | 99.295 | 0.005797 | 208.5840 | 99.525 | 0.013064 |
| 209.7750 | 99.636 | 0.013997 | 209.8510 | 99.288 | 0.012627 | 209.6130 | 99.505 | 0.011914 |
| 210.8090 | 99.630 | 0.001073 | 210.8740 | 99.271 | 0.016873 | 210.6460 | 99.493 | 0.014159 |
| 211.8370 | 99.622 | 0.014889 | 211.9010 | 99.263 | 0.003489 | 211.6780 | 99.486 | -0.014717 |
| 212.8620 | 99.610 | 0.007530 | 212.9390 | 99.257 | -0.000921 | 212.7080 | 99.488 | 0.003899 |
| 213.9000 | 99.608 | 0.007177 | 213.9640 | 99.253 | 0.012287 | 213.7390 | 99.478 | 0.021239 |
| 214.9260 | 99.598 | 0.009036 | 215.0040 | 99.238 | 0.010907 | 214.7770 | 99.463 | 0.001909 |
| 215.9500 | 99.590 | 0.006211 | 216.0300 | 99.228 | 0.010936 | 215.7940 | 99.459 | 0.017801 |
| 216.9840 | 99.584 | 0.005897 | 217.0570 | 99.220 | -0.003834 | 216.8280 | 99.447 | 0.015180 |
| 218.0140 | 99.580 | 0.005152 | 218.0850 | 99.213 | 0.019591 | 217.8580 | 99.438 | -0.005750 |
| 219.0460 | 99.572 | 0.007833 | 219.1180 | 99.193 | 0.018794 | 218.9060 | 99.433 | 0.018597 |
| 220.0640 | 99.565 | 0.005999 | 220.1430 | 99.183 | 0.007968 | 219.9270 | 99.422 | -0.012288 |
| 221.1090 | 99.557 | 0.007077 | 221.1770 | 99.174 | 0.006863 | 220.9520 | 99.418 | 0.008863 |
| 222.1440 | 99.546 | 0.006441 | 222.2070 | 99.168 | 0.012564 | 221.9890 | 99.404 | 0.028119 |
| 223.1710 | 99.538 | 0.011501 | 223.2370 | 99.154 | 0.012417 | 223.0150 | 99.379 | 0.016213 |
| 224.2000 | 99.531 | -0.009666 | 224.2650 | 99.145 | 0.008794 | 224.0420 | 99.372 | 0.007895 |
| 225.2250 | 99.527 | 0.011883 | 225.2950 | 99.130 | 0.015693 | 225.0740 | 99.366 | 0.004670 |
| 226.2570 | 99.514 | 0.004771 | 226.3240 | 99.114 | 0.021165 | 226.1040 | 99.357 | 0.018570 |
| 227.2900 | 99.511 | 0.007283 | 227.3470 | 99.098 | 0.005504 | 227.1340 | 99.343 | 0.014364 |
| 228.3170 | 99.501 | 0.009893 | 228.3820 | 99.094 | 0.013027 | 228.1590 | 99.331 | 0.003819 |
| 229.3440 | 99.493 | 0.009639 | 229.4050 | 99.082 | 0.014404 | 229.1950 | 99.330 | 0.003268 |
| 230.3760 | 99.481 | 0.016755 | 230.4330 | 99.068 | 0.012158 | 230.2240 | 99.320 | 0.020847 |
| 231.4060 | 99.468 | 0.015077 | 231.4640 | 99.054 | 0.006469 | 231.2520 | 99.298 | 0.008109 |
| 232.4280 | 99.458 | 0.000661 | 232.4950 | 99.048 | 0.019802 | 232.2850 | 99.295 | 0.009847 |
| 233.4580 | 99.453 | 0.014569 | 233.5160 | 99.029 | 0.012824 | 233.3080 | 99.284 | 0.003535 |

Table C-2: Continued

| 1wt% MMT in Cross-Linked PMMA (10C/min) | | | 3wt% MMT in Cross-Linked PMMA (10C/min) | | | 5wt% MMT in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 234.4870 | 99.440 | 0.006661 | 234.5500 | 99.017 | 0.020384 | 234.3390 | 99.274 | 0.018069 |
| 235.5210 | 99.436 | 0.006899 | 235.5820 | 98.998 | 0.007905 | 235.3750 | 99.256 | 0.018675 |
| 236.5480 | 99.423 | 0.017785 | 236.6120 | 98.989 | 0.016367 | 236.3950 | 99.230 | 0.021645 |
| 237.5750 | 99.412 | 0.005964 | 237.6410 | 98.969 | 0.016174 | 237.4320 | 99.223 | -0.002178 |
| 238.6110 | 99.401 | 0.012521 | 238.6650 | 98.958 | 0.010524 | 238.4580 | 99.220 | 0.004828 |
| 239.6320 | 99.387 | 0.011215 | 239.6950 | 98.949 | 0.008031 | 239.4910 | 99.205 | 0.038755 |
| 240.6750 | 99.377 | 0.014705 | 240.7290 | 98.937 | 0.016909 | 240.5150 | 99.183 | 0.003324 |
| 241.6960 | 99.362 | 0.008005 | 241.7550 | 98.916 | 0.020859 | 241.5450 | 99.183 | 0.011727 |
| 242.7220 | 99.352 | 0.011152 | 242.7840 | 98.898 | 0.018392 | 242.5700 | 99.176 | 0.017713 |
| 243.7590 | 99.341 | 0.008016 | 243.8110 | 98.884 | 0.013209 | 243.5980 | 99.153 | 0.012510 |
| 244.7820 | 99.330 | 0.012228 | 244.8400 | 98.867 | 0.019280 | 244.6260 | 99.139 | 0.023100 |
| 245.8120 | 99.317 | 0.009647 | 245.8690 | 98.845 | 0.012989 | 245.6640 | 99.122 | -0.005153 |
| 246.8430 | 99.308 | 0.007989 | 246.8940 | 98.833 | 0.018444 | 246.6860 | 99.117 | 0.009197 |
| 247.8680 | 99.294 | 0.015026 | 247.9180 | 98.814 | 0.012299 | 247.7200 | 99.098 | 0.035044 |
| 248.8950 | 99.283 | 0.007499 | 248.9540 | 98.801 | 0.011842 | 248.7360 | 99.068 | 0.014024 |
| 249.9240 | 99.266 | 0.018942 | 249.9730 | 98.785 | 0.015562 | 249.7730 | 99.062 | 0.003026 |
| 250.9510 | 99.253 | 0.014453 | 251.0060 | 98.767 | 0.022899 | 250.8000 | 99.059 | 0.007725 |
| 251.9760 | 99.237 | 0.016911 | 252.0300 | 98.741 | 0.016806 | 251.8190 | 99.041 | 0.034043 |
| 253.0110 | 99.225 | 0.012408 | 253.0620 | 98.729 | 0.010620 | 252.8500 | 99.022 | 0.012899 |
| 254.0370 | 99.211 | 0.015860 | 254.0910 | 98.716 | 0.018590 | 253.8850 | 99.009 | 0.012061 |
| 255.0650 | 99.195 | 0.013660 | 255.1120 | 98.695 | 0.020415 | 254.9070 | 98.997 | 0.024561 |
| 256.0920 | 99.179 | 0.018642 | 256.1390 | 98.674 | 0.015513 | 255.9340 | 98.973 | 0.017720 |
| 257.1200 | 99.167 | 0.010832 | 257.1660 | 98.660 | 0.015332 | 256.9650 | 98.958 | 0.019881 |
| 258.1540 | 99.151 | 0.026957 | 258.1960 | 98.640 | 0.020127 | 257.9860 | 98.946 | 0.005640 |
| 259.1760 | 99.133 | 0.011308 | 259.2200 | 98.621 | 0.017171 | 259.0140 | 98.936 | 0.019003 |
| 260.2070 | 99.118 | 0.033288 | 260.2540 | 98.600 | 0.024990 | 260.0470 | 98.907 | 0.033730 |
| 261.2300 | 99.094 | 0.011838 | 261.2790 | 98.581 | 0.016787 | 261.0710 | 98.870 | 0.020367 |
| 262.2560 | 99.081 | 0.021877 | 262.3110 | 98.561 | 0.029592 | 262.0970 | 98.865 | -0.002724 |
| 263.2870 | 99.065 | 0.012519 | 263.3260 | 98.538 | 0.012238 | 263.1300 | 98.864 | 0.014491 |
| 264.3100 | 99.047 | 0.022455 | 264.3490 | 98.526 | 0.018260 | 264.1560 | 98.842 | 0.021134 |
| 265.3390 | 99.028 | 0.011827 | 265.3810 | 98.505 | 0.020303 | 265.1730 | 98.820 | 0.020731 |
| 266.3660 | 99.010 | 0.023618 | 266.4130 | 98.481 | 0.026481 | 266.2070 | 98.800 | 0.009741 |
| 267.3890 | 98.988 | 0.018672 | 267.4310 | 98.460 | 0.015220 | 267.2320 | 98.785 | 0.031952 |
| 268.4160 | 98.968 | 0.022082 | 268.4630 | 98.442 | 0.018905 | 268.2510 | 98.763 | 0.018013 |
| 269.4380 | 98.943 | 0.020302 | 269.4790 | 98.417 | 0.024874 | 269.2840 | 98.743 | 0.020752 |
| 270.4670 | 98.923 | 0.024803 | 270.5020 | 98.395 | 0.018901 | 270.3010 | 98.733 | 0.011414 |
| 271.4930 | 98.896 | 0.022662 | 271.5260 | 98.379 | 0.018979 | 271.3300 | 98.712 | 0.028786 |
| 272.5190 | 98.877 | 0.019502 | 272.5600 | 98.356 | 0.025468 | 272.3590 | 98.685 | 0.028158 |
| 273.5400 | 98.857 | 0.020180 | 273.5780 | 98.329 | 0.028789 | 273.3880 | 98.660 | 0.012030 |
| 274.5680 | 98.836 | 0.026645 | 274.6060 | 98.303 | 0.018321 | 274.4140 | 98.647 | 0.013452 |
| 275.5950 | 98.809 | 0.026398 | 275.6310 | 98.284 | 0.021507 | 275.4380 | 98.635 | 0.026513 |
| 276.6110 | 98.785 | 0.024723 | 276.6550 | 98.260 | 0.026171 | 276.4640 | 98.608 | 0.019339 |
| 277.6420 | 98.754 | 0.031975 | 277.6760 | 98.241 | 0.007054 | 277.4830 | 98.591 | 0.024920 |
| 278.6650 | 98.730 | 0.022280 | 278.7020 | 98.218 | 0.028801 | 278.5070 | 98.567 | 0.019504 |
| 279.6880 | 98.705 | 0.040998 | 279.7260 | 98.192 | 0.019205 | 279.5320 | 98.544 | 0.028631 |
| 280.7180 | 98.673 | 0.023272 | 280.7540 | 98.168 | 0.025159 | 280.5550 | 98.521 | 0.022513 |
| 281.7470 | 98.652 | 0.031995 | 281.7780 | 98.143 | 0.023766 | 281.5770 | 98.499 | 0.012935 |
| 282.7700 | 98.625 | 0.025458 | 282.7970 | 98.114 | 0.028498 | 282.6130 | 98.490 | 0.012921 |
| 283.7960 | 98.600 | 0.029491 | 283.8280 | 98.090 | 0.016974 | 283.6300 | 98.467 | 0.030126 |
| 284.8150 | 98.569 | 0.031711 | 284.8550 | 98.067 | 0.026062 | 284.6500 | 98.432 | 0.038875 |
| 285.8360 | 98.538 | 0.028447 | 285.8690 | 98.037 | 0.037890 | 285.6740 | 98.400 | 0.018548 |
| 286.8630 | 98.503 | 0.032499 | 286.9010 | 98.009 | 0.024144 | 286.6980 | 98.388 | 0.018322 |
| 287.8850 | 98.476 | 0.023948 | 287.9130 | 97.984 | 0.024326 | 287.7260 | 98.368 | 0.022493 |
| 288.9050 | 98.444 | 0.033421 | 288.9390 | 97.956 | 0.032053 | 288.7460 | 98.339 | 0.026237 |
| 289.9270 | 98.412 | 0.017480 | 289.9650 | 97.922 | 0.025021 | 289.7780 | 98.319 | 0.018470 |
| 290.9510 | 98.383 | 0.032347 | 290.9920 | 97.896 | 0.024913 | 290.8000 | 98.300 | 0.020920 |
| 291.9700 | 98.351 | 0.024968 | 292.0100 | 97.870 | 0.033182 | 291.8250 | 98.278 | 0.025396 |
| 292.9940 | 98.323 | 0.031751 | 293.0390 | 97.832 | 0.031884 | 292.8520 | 98.249 | 0.030935 |
| 294.0200 | 98.286 | 0.029931 | 294.0540 | 97.805 | 0.021934 | 293.8700 | 98.219 | 0.022845 |
| 295.0440 | 98.255 | 0.030815 | 295.0770 | 97.780 | 0.025822 | 294.8890 | 98.203 | 0.012227 |
| 296.0720 | 98.218 | 0.034513 | 296.1050 | 97.750 | 0.040005 | 295.9170 | 98.185 | 0.020577 |
| 297.0930 | 98.183 | 0.030638 | 297.1290 | 97.711 | 0.031188 | 296.9420 | 98.154 | 0.046020 |
| 298.1120 | 98.150 | 0.031652 | 298.1440 | 97.684 | 0.027716 | 297.9560 | 98.118 | 0.024505 |
| 299.1360 | 98.114 | 0.032690 | 299.1680 | 97.653 | 0.036596 | 298.9830 | 98.091 | 0.032058 |
| 300.1630 | 98.080 | 0.034512 | 300.1920 | 97.616 | 0.034278 | 300.0070 | 98.066 | 0.027053 |

Table C-2: Continued

| 1wt% MMT in Cross-Linked PMMA (10C/min) | | | 3wt% MMT in Cross-Linked PMMA (10C/min) | | | 5wt% MMT in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 301.1850 | 98.038 | 0.037532 | 301.2160 | 97.582 | 0.029121 | 301.0290 | 98.031 | 0.046871 |
| 302.2030 | 98.006 | 0.034813 | 302.2400 | 97.556 | 0.026939 | 302.0500 | 98.003 | 0.022823 |
| 303.2170 | 97.965 | 0.045449 | 303.2540 | 97.521 | 0.037853 | 303.0790 | 97.977 | 0.024229 |
| 304.2440 | 97.924 | 0.038959 | 304.2770 | 97.485 | 0.035656 | 304.1000 | 97.951 | 0.032760 |
| 305.2670 | 97.884 | 0.040057 | 305.2990 | 97.445 | 0.038868 | 305.1130 | 97.917 | 0.028757 |
| 306.2810 | 97.847 | 0.039544 | 306.3140 | 97.409 | 0.035440 | 306.1420 | 97.880 | 0.037364 |
| 307.3050 | 97.805 | 0.042269 | 307.3410 | 97.370 | 0.037921 | 307.1570 | 97.851 | 0.024409 |
| 308.3250 | 97.765 | 0.037939 | 308.3630 | 97.331 | 0.039829 | 308.1850 | 97.821 | 0.038401 |
| 309.3410 | 97.721 | 0.050737 | 309.3840 | 97.290 | 0.039788 | 309.1990 | 97.781 | 0.038446 |
| 310.3670 | 97.673 | 0.042881 | 310.4020 | 97.246 | 0.049032 | 310.2200 | 97.740 | 0.037818 |
| 311.3850 | 97.630 | 0.050810 | 311.4250 | 97.197 | 0.032780 | 311.2430 | 97.701 | 0.040160 |
| 312.4100 | 97.581 | 0.044685 | 312.4430 | 97.155 | 0.048041 | 312.2570 | 97.660 | 0.041436 |
| 313.4290 | 97.537 | 0.043912 | 313.4600 | 97.105 | 0.054959 | 313.2860 | 97.611 | 0.053061 |
| 314.4470 | 97.489 | 0.047105 | 314.4850 | 97.054 | 0.051585 | 314.3030 | 97.569 | 0.037814 |
| 315.4730 | 97.441 | 0.047552 | 315.5060 | 97.002 | 0.049096 | 315.3250 | 97.523 | 0.045585 |
| 316.4910 | 97.392 | 0.051058 | 316.5170 | 96.953 | 0.053893 | 316.3430 | 97.474 | 0.059106 |
| 317.5070 | 97.340 | 0.052036 | 317.5500 | 96.894 | 0.063198 | 317.3660 | 97.408 | 0.065407 |
| 318.5260 | 97.287 | 0.057546 | 318.5620 | 96.835 | 0.058720 | 318.3840 | 97.348 | 0.068655 |
| 319.5490 | 97.230 | 0.056448 | 319.5780 | 96.773 | 0.060775 | 319.4090 | 97.284 | 0.056670 |
| 320.5640 | 97.175 | 0.053598 | 320.5990 | 96.707 | 0.066930 | 320.4190 | 97.231 | 0.056617 |
| 321.5910 | 97.116 | 0.056303 | 321.6170 | 96.640 | 0.065131 | 321.4420 | 97.168 | 0.071680 |
| 322.6050 | 97.061 | 0.056142 | 322.6360 | 96.575 | 0.063190 | 322.4490 | 97.090 | 0.086623 |
| 323.6270 | 96.998 | 0.066574 | 323.6530 | 96.507 | 0.071390 | 323.4780 | 97.010 | 0.071619 |
| 324.6430 | 96.931 | 0.063365 | 324.6790 | 96.432 | 0.074519 | 324.4920 | 96.936 | 0.080801 |
| 325.6580 | 96.866 | 0.069409 | 325.6940 | 96.357 | 0.074807 | 325.5080 | 96.851 | 0.088890 |
| 326.6860 | 96.787 | 0.076963 | 326.7120 | 96.280 | 0.084121 | 326.5290 | 96.758 | 0.072366 |
| 327.7010 | 96.716 | 0.067053 | 327.7300 | 96.191 | 0.091967 | 327.5530 | 96.679 | 0.088036 |
| 328.7190 | 96.635 | 0.084620 | 328.7450 | 96.107 | 0.079453 | 328.5640 | 96.588 | 0.090284 |
| 329.7390 | 96.554 | 0.076942 | 329.7610 | 96.021 | 0.082546 | 329.5860 | 96.487 | 0.108185 |
| 330.7620 | 96.471 | 0.099700 | 330.7830 | 95.930 | 0.100502 | 330.5980 | 96.384 | 0.083960 |
| 331.7740 | 96.377 | 0.094338 | 331.7970 | 95.824 | 0.097508 | 331.6210 | 96.290 | 0.093000 |
| 332.7930 | 96.275 | 0.110788 | 332.8110 | 95.727 | 0.105851 | 332.6360 | 96.194 | 0.119592 |
| 333.8120 | 96.164 | 0.110974 | 333.8320 | 95.620 | 0.109445 | 333.6580 | 96.085 | 0.103449 |
| 334.8290 | 96.047 | 0.127170 | 334.8470 | 95.510 | 0.124028 | 334.6730 | 95.984 | 0.105934 |
| 335.8450 | 95.922 | 0.122413 | 335.8660 | 95.384 | 0.116618 | 335.6870 | 95.874 | 0.115280 |
| 336.8620 | 95.793 | 0.140764 | 336.8840 | 95.264 | 0.130064 | 336.6990 | 95.754 | 0.121092 |
| 337.8770 | 95.645 | 0.145303 | 337.8960 | 95.134 | 0.136090 | 337.7220 | 95.625 | 0.140439 |
| 338.8980 | 95.494 | 0.151264 | 338.9130 | 94.995 | 0.147227 | 338.7410 | 95.463 | 0.143144 |
| 339.9150 | 95.329 | 0.173995 | 339.9230 | 94.845 | 0.144922 | 339.7600 | 95.323 | 0.126788 |
| 340.9250 | 95.150 | 0.181382 | 340.9340 | 94.695 | 0.156260 | 340.7850 | 95.192 | 0.132960 |
| 341.9400 | 94.961 | 0.188060 | 341.9570 | 94.526 | 0.174597 | 341.8020 | 95.040 | 0.162109 |
| 342.9600 | 94.750 | 0.217742 | 342.9780 | 94.348 | 0.184418 | 342.8170 | 94.875 | 0.157282 |
| 343.9730 | 94.533 | 0.213843 | 343.9870 | 94.163 | 0.186903 | 343.8290 | 94.713 | 0.161591 |
| 344.9880 | 94.299 | 0.232178 | 345.0040 | 93.967 | 0.215690 | 344.8450 | 94.550 | 0.159964 |
| 346.0030 | 94.046 | 0.270143 | 346.0170 | 93.756 | 0.205708 | 345.8600 | 94.375 | 0.179912 |
| 347.0170 | 93.755 | 0.306451 | 347.0370 | 93.538 | 0.226689 | 346.8760 | 94.193 | 0.173027 |
| 348.0330 | 93.426 | 0.343804 | 348.0460 | 93.297 | 0.254162 | 347.8870 | 94.011 | 0.176681 |
| 349.0410 | 93.064 | 0.385051 | 349.0620 | 93.038 | 0.254070 | 348.9090 | 93.815 | 0.207989 |
| 350.0570 | 92.657 | 0.417687 | 350.0760 | 92.766 | 0.284888 | 349.9200 | 93.594 | 0.229575 |
| 351.0620 | 92.233 | 0.429335 | 351.0850 | 92.472 | 0.299491 | 350.9320 | 93.361 | 0.230668 |
| 352.0760 | 91.761 | 0.480842 | 352.0980 | 92.150 | 0.331930 | 351.9480 | 93.117 | 0.241748 |
| 353.0800 | 91.255 | 0.521862 | 353.1060 | 91.813 | 0.337232 | 352.9690 | 92.872 | 0.271472 |
| 354.0850 | 90.685 | 0.592815 | 354.1200 | 91.458 | 0.374954 | 353.9760 | 92.605 | 0.279662 |
| 355.0980 | 90.061 | 0.647182 | 355.1330 | 91.067 | 0.408018 | 354.9860 | 92.313 | 0.295328 |
| 356.1020 | 89.396 | 0.660405 | 356.1360 | 90.645 | 0.418987 | 356.0010 | 92.008 | 0.310754 |
| 357.1100 | 88.687 | 0.725315 | 357.1590 | 90.202 | 0.490155 | 357.0110 | 91.679 | 0.333691 |
| 358.1190 | 87.928 | 0.830021 | 358.1640 | 89.715 | 0.526138 | 358.0190 | 91.334 | 0.351751 |
| 359.1200 | 87.112 | 0.816125 | 359.1640 | 89.187 | 0.520533 | 359.0300 | 90.955 | 0.381904 |
| 360.1290 | 86.252 | 0.920527 | 360.1730 | 88.628 | 0.584069 | 360.0400 | 90.553 | 0.436066 |
| 361.1390 | 85.323 | 0.967218 | 361.1780 | 88.025 | 0.629971 | 361.0480 | 90.125 | 0.437045 |
| 362.1410 | 84.236 | 1.201234 | 362.1840 | 87.379 | 0.685418 | 362.0560 | 89.671 | 0.486363 |
| 363.1450 | 83.063 | 1.129031 | 363.1830 | 86.670 | 0.718601 | 363.0670 | 89.168 | 0.516774 |
| 364.1480 | 81.893 | 1.206755 | 364.1940 | 85.912 | 0.823498 | 364.0760 | 88.624 | 0.557777 |
| 365.1470 | 80.695 | 1.237897 | 365.1950 | 85.087 | 0.832331 | 365.0890 | 88.053 | 0.589545 |
| 366.1500 | 79.460 | 1.246123 | 366.1980 | 84.213 | 0.954167 | 366.0950 | 87.445 | 0.640859 |

Table C-2: Continued

| 1wt% MMT in Cross-Linked PMMA (10C/min) | | | 3wt% MMT in Cross-Linked PMMA (10C/min) | | | 5wt% MMT in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 367.1510 | 78.167 | 1.250551 | 367.2030 | 83.254 | 0.998230 | 367.0980 | 86.779 | 0.692762 |
| 368.1600 | 76.830 | 1.415905 | 368.2030 | 82.211 | 1.165264 | 368.1070 | 86.034 | 0.773452 |
| 369.1570 | 75.435 | 1.446401 | 369.2020 | 81.002 | 1.213511 | 369.1020 | 85.231 | 0.818014 |
| 370.1640 | 73.956 | 1.634707 | 370.1960 | 79.792 | 1.208842 | 370.1080 | 84.387 | 0.870194 |
| 371.1600 | 72.320 | 1.571845 | 371.2080 | 78.554 | 1.273780 | 371.1090 | 83.492 | 0.924135 |
| 372.1650 | 70.688 | 1.630661 | 372.2060 | 77.280 | 1.226532 | 372.1150 | 82.552 | 0.974057 |
| 373.1650 | 69.063 | 1.644517 | 373.1980 | 75.962 | 1.351488 | 373.1110 | 81.571 | 1.022903 |
| 374.1630 | 67.401 | 1.583102 | 374.2010 | 74.534 | 1.505714 | 374.1160 | 80.537 | 1.082814 |
| 375.1710 | 65.709 | 1.785467 | 375.2060 | 72.998 | 1.546580 | 375.1200 | 79.441 | 1.194918 |
| 376.1800 | 63.960 | 1.827173 | 376.2090 | 71.447 | 1.480609 | 376.1160 | 78.230 | 1.301037 |
| 377.1830 | 62.186 | 1.720885 | 377.2130 | 69.779 | 1.718610 | 377.1160 | 76.874 | 1.369040 |
| 378.1920 | 60.381 | 1.861129 | 378.2090 | 68.071 | 1.682365 | 378.1080 | 75.525 | 1.308392 |
| 379.1960 | 58.482 | 1.873873 | 379.2130 | 66.352 | 1.775269 | 379.1190 | 74.151 | 1.462888 |
| 380.1970 | 56.600 | 1.887364 | 380.2270 | 64.594 | 1.962201 | 380.1180 | 72.659 | 1.530702 |
| 381.2100 | 54.712 | 1.968845 | 381.2090 | 62.776 | 1.791054 | 381.1190 | 71.132 | 1.537265 |
| 382.2090 | 52.838 | 1.809990 | 382.2160 | 60.954 | 1.752822 | 382.1190 | 69.604 | 1.526834 |
| 383.2190 | 50.985 | 1.800743 | 383.2260 | 59.150 | 1.831703 | 383.1310 | 68.034 | 1.662671 |
| 384.2300 | 49.112 | 1.908603 | 384.2270 | 57.321 | 1.815580 | 384.1300 | 66.429 | 1.618115 |
| 385.2380 | 47.273 | 1.774827 | 385.2400 | 55.450 | 1.941534 | 385.1250 | 64.815 | 1.623526 |
| 386.2520 | 45.462 | 1.809686 | 386.2430 | 53.581 | 1.820182 | 386.1330 | 63.189 | 1.628098 |
| 387.2650 | 43.675 | 1.774658 | 387.2430 | 51.724 | 1.809597 | 387.1380 | 61.558 | 1.680830 |
| 388.2810 | 41.911 | 1.792167 | 388.2610 | 49.889 | 1.805114 | 388.1460 | 59.911 | 1.713441 |
| 389.2950 | 40.189 | 1.679636 | 389.2660 | 48.059 | 1.786638 | 389.1520 | 58.240 | 1.676578 |
| 390.3040 | 38.513 | 1.603257 | 390.2830 | 46.236 | 1.794234 | 390.1550 | 56.570 | 1.619328 |
| 391.3220 | 36.864 | 1.630292 | 391.2910 | 44.442 | 1.631008 | 391.1710 | 54.927 | 1.696887 |
| 392.3430 | 35.270 | 1.478869 | 392.3080 | 42.691 | 1.678795 | 392.1760 | 53.292 | 1.661252 |
| 393.3630 | 33.721 | 1.541479 | 393.3230 | 40.958 | 1.671143 | 393.1840 | 51.667 | 1.603639 |
| 394.3760 | 32.220 | 1.431654 | 394.3440 | 39.250 | 1.651213 | 394.2070 | 50.059 | 1.600565 |
| 395.4000 | 30.777 | 1.389691 | 395.3680 | 37.562 | 1.659150 | 395.2190 | 48.468 | 1.578334 |
| 396.4240 | 29.377 | 1.370329 | 396.3730 | 35.932 | 1.532481 | 396.2310 | 46.902 | 1.559195 |
| 397.4430 | 28.035 | 1.277801 | 397.4030 | 34.339 | 1.566441 | 397.2450 | 45.355 | 1.496856 |
| 398.4620 | 26.752 | 1.208353 | 398.4170 | 32.783 | 1.461819 | 398.2670 | 43.847 | 1.458337 |
| 399.4880 | 25.517 | 1.155464 | 399.4360 | 31.277 | 1.449245 | 399.2820 | 42.388 | 1.492032 |
| 400.5150 | 24.334 | 1.186494 | 400.4530 | 29.820 | 1.399911 | 400.2960 | 40.954 | 1.416629 |
| 401.5310 | 23.198 | 1.095526 | 401.4800 | 28.407 | 1.299429 | 401.3210 | 39.546 | 1.448181 |
| 402.5520 | 22.113 | 1.012674 | 402.5090 | 27.042 | 1.287765 | 402.3320 | 38.184 | 1.283752 |
| 403.5770 | 21.074 | 0.957029 | 403.5280 | 25.726 | 1.255258 | 403.3470 | 36.855 | 1.240611 |
| 404.6000 | 20.097 | 0.911630 | 404.5480 | 24.454 | 1.184189 | 404.3760 | 35.572 | 1.213231 |
| 405.6220 | 19.171 | 0.876016 | 405.5800 | 23.233 | 1.155015 | 405.3960 | 34.333 | 1.205204 |
| 406.6480 | 18.286 | 0.808139 | 406.6050 | 22.065 | 1.122955 | 406.4130 | 33.133 | 1.144404 |
| 407.6740 | 17.459 | 0.794111 | 407.6150 | 20.951 | 1.058452 | 407.4270 | 31.982 | 1.073499 |
| 408.6950 | 16.678 | 0.741483 | 408.6450 | 19.873 | 0.993623 | 408.4630 | 30.881 | 1.033884 |
| 409.7250 | 15.940 | 0.719798 | 409.6710 | 18.855 | 0.963752 | 409.4840 | 29.819 | 1.019052 |
| 410.7440 | 15.258 | 0.626751 | 410.7000 | 17.889 | 0.947415 | 410.5070 | 28.806 | 0.929813 |
| 411.7790 | 14.611 | 0.620693 | 411.7260 | 16.963 | 0.901645 | 411.5280 | 27.856 | 0.903164 |
| 412.7940 | 14.016 | 0.554959 | 412.7430 | 16.085 | 0.833062 | 412.5510 | 26.965 | 0.845252 |
| 413.8200 | 13.463 | 0.512208 | 413.7670 | 15.269 | 0.761907 | 413.5820 | 26.115 | 0.837384 |
| 414.8330 | 12.950 | 0.461295 | 414.7960 | 14.500 | 0.731405 | 414.5950 | 25.302 | 0.734583 |
| 415.8550 | 12.475 | 0.443342 | 415.8140 | 13.785 | 0.684504 | 415.6220 | 24.545 | 0.704082 |
| 416.8880 | 12.033 | 0.434783 | 416.8390 | 13.121 | 0.606923 | 416.6510 | 23.861 | 0.696136 |
| 417.9030 | 11.627 | 0.387604 | 417.8640 | 12.516 | 0.564306 | 417.6700 | 23.225 | 0.605839 |
| 418.9200 | 11.253 | 0.330812 | 418.8870 | 11.949 | 0.504316 | 418.6950 | 22.634 | 0.583678 |
| 419.9380 | 10.921 | 0.300692 | 419.9200 | 11.435 | 0.484819 | 419.7110 | 22.087 | 0.497522 |
| 420.9650 | 10.610 | 0.295561 | 420.9410 | 10.976 | 0.415776 | 420.7300 | 21.580 | 0.483019 |
| 421.9830 | 10.327 | 0.262072 | 421.9630 | 10.557 | 0.392136 | 421.7500 | 21.135 | 0.419580 |
| 423.0010 | 10.066 | 0.242594 | 422.9790 | 10.179 | 0.320136 | 422.7730 | 20.718 | 0.405277 |
| 424.0200 | 9.822 | 0.222057 | 424.0050 | 9.854 | 0.304858 | 423.7890 | 20.339 | 0.350791 |
| 425.0350 | 9.604 | 0.208850 | 425.0270 | 9.557 | 0.279232 | 424.8080 | 19.994 | 0.312219 |
| 426.0490 | 9.402 | 0.188803 | 426.0400 | 9.294 | 0.241983 | 425.8340 | 19.692 | 0.293975 |
| 427.0730 | 9.219 | 0.155172 | 427.0670 | 9.061 | 0.220314 | 426.8410 | 19.400 | 0.260060 |
| 428.0870 | 9.053 | 0.163050 | 428.0780 | 8.852 | 0.187677 | 427.8590 | 19.142 | 0.236340 |
| 429.0980 | 8.887 | 0.151325 | 429.1010 | 8.661 | 0.177204 | 428.8810 | 18.896 | 0.217036 |
| 430.1120 | 8.739 | 0.149811 | 430.1130 | 8.497 | 0.146632 | 429.9020 | 18.691 | 0.196777 |
| 431.1270 | 8.594 | 0.137877 | 431.1280 | 8.346 | 0.138905 | 430.9130 | 18.499 | 0.195236 |
| 432.1330 | 8.468 | 0.120565 | 432.1410 | 8.211 | 0.134790 | 431.9190 | 18.305 | 0.181560 |
| 433.1480 | 8.348 | 0.118438 | 433.1510 | 8.084 | 0.111480 | 432.9350 | 18.130 | 0.156361 |

Table C-2: Continued

| 1wt% MMT in Cross-Linked PMMA (10C/min) | | | 3wt% MMT in Cross-Linked PMMA (10C/min) | | | 5wt% MMT in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 434.1490 | 8.232 | 0.107543 | 434.1680 | 7.978 | 0.102973 | 433.9470 | 17.976 | 0.146025 |
| 435.1640 | 8.125 | 0.103134 | 435.1880 | 7.874 | 0.109665 | 434.9630 | 17.831 | 0.137588 |
| 436.1820 | 8.019 | 0.105075 | 436.1930 | 7.777 | 0.084559 | 435.9780 | 17.693 | 0.131377 |
| 437.1880 | 7.916 | 0.101254 | 437.1970 | 7.691 | 0.083525 | 436.9910 | 17.564 | 0.121319 |
| 438.1990 | 7.810 | 0.101456 | 438.2090 | 7.606 | 0.082425 | 438.0040 | 17.447 | 0.119291 |
| 439.2120 | 7.720 | 0.089151 | 439.2200 | 7.524 | 0.075984 | 439.0080 | 17.328 | 0.108957 |
| 440.2090 | 7.627 | 0.099349 | 440.2200 | 7.453 | 0.062779 | 440.0240 | 17.217 | 0.109793 |
| 441.2140 | 7.537 | 0.077633 | 441.2330 | 7.392 | 0.070245 | 441.0390 | 17.115 | 0.097040 |
| 442.2330 | 7.455 | 0.091642 | 442.2420 | 7.320 | 0.072329 | 442.0510 | 17.021 | 0.093140 |
| 443.2450 | 7.363 | 0.085352 | 443.2510 | 7.256 | 0.059062 | 443.0590 | 16.936 | 0.083794 |
| 444.2520 | 7.283 | 0.087668 | 444.2480 | 7.201 | 0.057295 | 444.0600 | 16.843 | 0.086757 |
| 445.2560 | 7.194 | 0.082656 | 445.2630 | 7.140 | 0.058689 | 445.0810 | 16.756 | 0.080041 |
| 446.2620 | 7.117 | 0.075165 | 446.2710 | 7.081 | 0.050994 | 446.0890 | 16.676 | 0.072010 |
| 447.2760 | 7.033 | 0.082256 | 447.2810 | 7.035 | 0.048770 | 447.0970 | 16.608 | 0.067560 |
| 448.2820 | 6.957 | 0.066974 | 448.2810 | 6.985 | 0.050156 | 448.1110 | 16.537 | 0.064564 |
| 449.2840 | 6.882 | 0.075840 | 449.2890 | 6.932 | 0.052657 | 449.1200 | 16.467 | 0.075688 |
| 450.2970 | 6.801 | 0.078504 | 450.2980 | 6.886 | 0.029399 | 450.1330 | 16.387 | 0.075546 |
| 451.3030 | 6.727 | 0.076536 | 451.3000 | 6.848 | 0.042576 | 451.1440 | 16.318 | 0.064658 |
| 452.3140 | 6.648 | 0.078821 | 452.3090 | 6.803 | 0.045083 | 452.1540 | 16.255 | 0.061562 |
| 453.3200 | 6.575 | 0.065920 | 453.3090 | 6.763 | 0.038298 | 453.1600 | 16.197 | 0.063059 |
| 454.3240 | 6.507 | 0.071405 | 454.3190 | 6.721 | 0.042596 | 454.1710 | 16.134 | 0.056707 |
| 455.3310 | 6.436 | 0.065677 | 455.3180 | 6.677 | 0.039251 | 455.1760 | 16.083 | 0.048651 |
| 456.3400 | 6.366 | 0.067660 | 456.3240 | 6.644 | 0.030409 | 456.1850 | 16.036 | 0.048162 |
| 457.3560 | 6.298 | 0.065888 | 457.3320 | 6.611 | 0.031470 | 457.1940 | 15.975 | 0.069575 |
| 458.3560 | 6.233 | 0.062247 | 458.3500 | 6.581 | 0.031793 | 458.2120 | 15.924 | 0.039748 |
| 459.3640 | 6.167 | 0.064353 | 459.3510 | 6.549 | 0.029283 | 459.2180 | 15.883 | 0.044350 |
| 460.3710 | 6.102 | 0.060852 | 460.3620 | 6.525 | 0.022541 | 460.2280 | 15.841 | 0.037320 |
| 461.3770 | 6.041 | 0.063634 | 461.3620 | 6.497 | 0.034969 | 461.2330 | 15.805 | 0.039860 |
| 462.3890 | 5.978 | 0.053121 | 462.3650 | 6.465 | 0.025224 | 462.2370 | 15.767 | 0.040678 |
| 463.3980 | 5.931 | 0.047299 | 463.3780 | 6.444 | 0.014953 | 463.2480 | 15.725 | 0.038734 |
| 464.3990 | 5.877 | 0.053279 | 464.3800 | 6.427 | 0.020785 | 464.2610 | 15.690 | 0.031849 |
| 465.4130 | 5.822 | 0.046451 | 465.3870 | 6.403 | 0.024330 | 465.2680 | 15.661 | 0.031611 |
| 466.4130 | 5.779 | 0.045870 | 466.3920 | 6.380 | 0.022896 | 466.2830 | 15.630 | 0.033321 |
| 467.4250 | 5.725 | 0.047173 | 467.3930 | 6.367 | 0.008875 | 467.2790 | 15.595 | 0.031539 |
| 468.4310 | 5.687 | 0.031245 | 468.3990 | 6.352 | 0.020387 | 468.2920 | 15.574 | 0.016436 |
| 469.4360 | 5.650 | 0.038897 | 469.4070 | 6.332 | 0.009368 | 469.2970 | 15.555 | 0.019566 |
| 470.4450 | 5.616 | 0.032094 | 470.4070 | 6.322 | 0.013599 | 470.2990 | 15.531 | 0.034997 |
| 471.4500 | 5.580 | 0.041165 | 471.4190 | 6.306 | 0.018110 | 471.3140 | 15.491 | 0.029577 |
| 472.4520 | 5.544 | 0.027220 | 472.4270 | 6.287 | 0.009764 | 472.3230 | 15.484 | -0.003221 |
| 473.4540 | 5.519 | 0.026530 | 473.4310 | 6.281 | 0.013752 | 473.3310 | 15.481 | 0.006761 |
| 474.4590 | 5.489 | 0.026576 | 474.4360 | 6.273 | 0.008414 | 474.3360 | 15.470 | 0.020464 |
| 475.4710 | 5.469 | 0.011090 | 475.4440 | 6.263 | 0.014225 | 475.3480 | 15.447 | 0.019376 |
| 476.4780 | 5.450 | 0.023859 | 476.4470 | 6.252 | 0.011514 | 476.3540 | 15.426 | 0.025857 |
| 477.4760 | 5.427 | 0.017218 | 477.4520 | 6.244 | 0.002292 | 477.3600 | 15.407 | 0.012428 |
| 478.4800 | 5.412 | 0.010419 | 478.4550 | 6.232 | 0.010506 | 478.3680 | 15.399 | 0.005493 |
| 479.4970 | 5.399 | 0.015997 | 479.4610 | 6.224 | 0.003932 | 479.3780 | 15.394 | 0.006524 |
| 480.4900 | 5.380 | 0.016429 | 480.4570 | 6.224 | -0.000083 | 480.3900 | 15.381 | 0.017182 |
| 481.4990 | 5.364 | 0.012440 | 481.4700 | 6.215 | 0.007248 | 481.3900 | 15.363 | 0.019201 |
| 482.5000 | 5.349 | 0.009108 | 482.4700 | 6.210 | 0.007335 | 482.3930 | 15.353 | -0.008694 |
| 483.5000 | 5.341 | 0.007022 | 483.4740 | 6.201 | 0.005287 | 483.4020 | 15.348 | 0.004579 |
| 484.5120 | 5.329 | 0.006239 | 484.4750 | 6.195 | 0.003416 | 484.4150 | 15.340 | 0.015812 |
| 485.5130 | 5.323 | 0.011348 | 485.4830 | 6.189 | 0.015561 | 485.4190 | 15.329 | 0.003888 |
| 486.5130 | 5.307 | 0.008082 | 486.4810 | 6.176 | 0.002716 | 486.4310 | 15.329 | -0.004147 |
| 487.5220 | 5.306 | 0.000851 | 487.4950 | 6.176 | 0.003746 | 487.4350 | 15.322 | 0.008832 |
| 488.5220 | 5.297 | 0.013645 | 488.5000 | 6.165 | 0.012849 | 488.4380 | 15.313 | 0.022109 |
| 489.5280 | 5.288 | 0.005632 | 489.4980 | 6.160 | -0.003954 | 489.4480 | 15.290 | 0.011046 |
| 490.5290 | 5.281 | 0.014236 | 490.5070 | 6.162 | -0.000887 | 490.4490 | 15.289 | 0.005260 |
| 491.5440 | 5.269 | 0.004438 | 491.5050 | 6.159 | 0.014114 | 491.4650 | 15.279 | 0.009474 |
| 492.5430 | 5.273 | 0.000721 | 492.5140 | 6.146 | 0.006606 | 492.4590 | 15.277 | 0.000707 |
| 493.5480 | 5.266 | 0.007655 | 493.5130 | 6.141 | 0.004441 | 493.4700 | 15.264 | 0.019569 |
| 494.5460 | 5.261 | -0.003416 | 494.5190 | 6.136 | 0.002881 | 494.4780 | 15.252 | -0.005294 |
| 495.5520 | 5.257 | 0.009254 | 495.5280 | 6.134 | 0.006044 | 495.4820 | 15.247 | 0.003026 |
| 496.5580 | 5.251 | -0.006044 | 496.5300 | 6.127 | -0.005954 | 496.4890 | 15.251 | -0.000799 |
| 497.5650 | 5.243 | 0.011845 | 497.5320 | 6.132 | 0.002435 | 497.4930 | 15.242 | 0.009111 |
| 498.5710 | 5.232 | -0.002589 | 498.5420 | 6.120 | 0.017322 | 498.4990 | 15.240 | -0.000572 |
| 499.5750 | 5.233 | 0.006332 | 499.5490 | 6.110 | 0.000181 | 499.5130 | 15.235 | 0.004319 |

Table C-2: Continued

| 1wt% MMT in Cross-Linked PMMA (10C/min) | | | 3wt% MMT in Cross-Linked PMMA (10C/min) | | | 5wt% MMT in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 500.5840 | 5.225 | -0.003998 | 500.5540 | 6.111 | 0.008431 | 500.5180 | 15.236 | 0.002550 |
| 501.5790 | 5.226 | 0.001946 | 501.5540 | 6.105 | 0.006074 | 501.5230 | 15.228 | 0.010952 |
| 502.5860 | 5.224 | 0.005932 | 502.5620 | 6.098 | 0.009440 | 502.5290 | 15.215 | 0.016654 |
| 503.5920 | 5.217 | 0.005738 | 503.5660 | 6.092 | -0.000751 | 503.5410 | 15.196 | 0.002394 |
| 504.6000 | 5.215 | 0.006202 | 504.5790 | 6.093 | 0.008990 | 504.5440 | 15.200 | -0.009908 |
| 505.6040 | 5.204 | 0.013699 | 505.5810 | 6.080 | 0.011682 | 505.5490 | 15.201 | 0.002312 |

Table C-3: TGA and DTG for 1wt%, 3wt%, and 5wt% MMT in Linear PMMA

| 1wt% MMT in Linear PMMA (10C/min) | | | 3wt% MMT in Lineard PMMA (10C/min) | | | 5wt% MMT in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 100.1520 | 100.000 | -0.001065 | 100.0230 | 100.000 | 0.003546 | 100.1220 | 100.000 | 0.003810 |
| 101.1370 | 100.003 | -0.006027 | 101.0080 | 99.996 | -0.000961 | 101.1070 | 99.997 | -0.000988 |
| 102.1170 | 100.006 | -0.001146 | 101.9900 | 100.004 | -0.010561 | 102.0930 | 100.000 | -0.006166 |
| 103.0880 | 100.010 | -0.001083 | 102.9720 | 100.006 | -0.000824 | 103.0680 | 100.003 | 0.003997 |
| 104.0760 | 100.012 | -0.000937 | 103.9470 | 100.005 | -0.001023 | 104.0560 | 99.999 | 0.004069 |
| 105.0640 | 100.016 | -0.006228 | 104.9360 | 100.007 | -0.005672 | 105.0320 | 99.997 | -0.005948 |
| 106.0550 | 100.019 | -0.000960 | 105.9190 | 100.011 | -0.000874 | 106.0220 | 99.999 | 0.004069 |
| 107.0390 | 100.021 | -0.001057 | 106.9060 | 100.009 | 0.003801 | 107.0070 | 99.998 | 0.003809 |
| 108.0260 | 100.022 | -0.000680 | 107.8940 | 100.007 | -0.000922 | 107.9940 | 99.994 | -0.000645 |
| 109.0070 | 100.024 | -0.000922 | 108.8870 | 100.013 | -0.005405 | 108.9900 | 99.997 | 0.003812 |
| 110.0080 | 100.028 | -0.000874 | 109.8860 | 100.015 | 0.008557 | 109.9750 | 99.993 | 0.003972 |
| 110.9980 | 100.028 | -0.001065 | 110.8630 | 100.012 | 0.003303 | 110.9670 | 99.990 | -0.001061 |
| 111.9940 | 100.030 | -0.006063 | 111.8540 | 100.012 | -0.009902 | 111.9540 | 99.992 | 0.003948 |
| 112.9880 | 100.033 | -0.005955 | 112.8460 | 100.016 | -0.000864 | 112.9560 | 99.989 | 0.003948 |
| 113.9760 | 100.037 | -0.000921 | 113.8430 | 100.012 | -0.001085 | 113.9500 | 99.982 | 0.003770 |
| 114.9720 | 100.037 | -0.000979 | 114.8490 | 100.010 | -0.001011 | 114.9480 | 99.981 | -0.001019 |
| 115.9710 | 100.039 | 0.003961 | 115.8370 | 100.015 | -0.005427 | 115.9450 | 99.982 | 0.004043 |
| 116.9670 | 100.038 | -0.000695 | 116.8410 | 100.016 | 0.003798 | 116.9480 | 99.974 | 0.009156 |
| 117.9660 | 100.040 | -0.000785 | 117.8360 | 100.011 | -0.001001 | 117.9600 | 99.968 | 0.004018 |
| 118.9610 | 100.039 | -0.005818 | 118.8320 | 100.011 | -0.000918 | 118.9790 | 99.968 | -0.001138 |
| 119.9690 | 100.042 | 0.003985 | 119.8340 | 100.014 | -0.001029 | 119.9830 | 99.965 | 0.008470 |
| 120.9630 | 100.041 | -0.006001 | 120.8380 | 100.013 | 0.003642 | 121.0080 | 99.955 | 0.003737 |
| 121.9620 | 100.044 | 0.003783 | 121.8410 | 100.011 | -0.000958 | 122.0250 | 99.954 | -0.005660 |
| 122.9640 | 100.045 | -0.000979 | 122.8400 | 100.011 | -0.000949 | 123.0450 | 99.951 | 0.003879 |
| 123.9730 | 100.045 | -0.000799 | 123.8410 | 100.010 | 0.003856 | 124.0530 | 99.944 | 0.008429 |
| 124.9810 | 100.044 | 0.003985 | 124.8430 | 100.006 | 0.003823 | 125.0760 | 99.937 | 0.004020 |
| 125.9780 | 100.042 | -0.000869 | 125.8500 | 100.005 | 0.003804 | 126.0900 | 99.934 | -0.000861 |
| 126.9800 | 100.041 | 0.008634 | 126.8480 | 100.005 | -0.000718 | 127.1150 | 99.930 | 0.009187 |
| 128.0000 | 100.038 | 0.004412 | 127.8630 | 100.000 | 0.003438 | 128.1260 | 99.921 | 0.004136 |
| 129.0020 | 100.038 | -0.001027 | 128.8820 | 99.998 | -0.005004 | 129.1400 | 99.919 | -0.005877 |
| 130.0120 | 100.037 | -0.000813 | 129.8980 | 100.000 | 0.003643 | 130.1530 | 99.919 | 0.004114 |
| 131.0150 | 100.036 | 0.003801 | 130.9170 | 99.995 | 0.003816 | 131.1590 | 99.910 | 0.008493 |
| 132.0280 | 100.030 | -0.001128 | 131.9300 | 99.989 | 0.003457 | 132.1670 | 99.904 | 0.003900 |
| 133.0400 | 100.032 | -0.000864 | 132.9600 | 99.988 | 0.003517 | 133.1750 | 99.905 | -0.000898 |
| 134.0550 | 100.030 | 0.004056 | 133.9840 | 99.989 | -0.000916 | 134.1760 | 99.903 | 0.008757 |
| 135.0600 | 100.027 | -0.000899 | 135.0120 | 99.986 | 0.007786 | 135.1800 | 99.894 | -0.000902 |
| 136.0810 | 100.024 | 0.008769 | 136.0390 | 99.982 | 0.003732 | 136.1950 | 99.894 | -0.001227 |
| 137.1040 | 100.019 | -0.001295 | 137.0630 | 99.981 | 0.003824 | 137.1930 | 99.893 | 0.008196 |
| 138.1230 | 100.017 | 0.004177 | 138.0800 | 99.977 | 0.007586 | 138.1970 | 99.882 | 0.008527 |
| 139.1330 | 100.013 | 0.004122 | 139.1010 | 99.973 | -0.000854 | 139.2060 | 99.878 | -0.000668 |
| 140.1540 | 100.011 | 0.003890 | 140.1190 | 99.970 | -0.000688 | 140.2190 | 99.878 | -0.001082 |
| 141.1810 | 100.007 | 0.004151 | 141.1310 | 99.970 | 0.007615 | 141.2250 | 99.876 | 0.004346 |
| 142.1930 | 100.006 | 0.008615 | 142.1560 | 99.966 | -0.000847 | 142.2270 | 99.869 | 0.008896 |
| 143.2090 | 99.999 | 0.003543 | 143.1610 | 99.967 | 0.008216 | 143.2450 | 99.863 | -0.001092 |
| 144.2280 | 99.998 | -0.000780 | 144.1640 | 99.961 | -0.000895 | 144.2600 | 99.863 | 0.004041 |
| 145.2460 | 99.994 | 0.008494 | 145.1710 | 99.960 | 0.008077 | 145.2610 | 99.856 | 0.008615 |
| 146.2500 | 99.991 | 0.003665 | 146.1890 | 99.956 | -0.000639 | 146.2750 | 99.852 | 0.003948 |
| 147.2780 | 99.988 | 0.003821 | 147.2000 | 99.956 | 0.003663 | 147.2870 | 99.848 | 0.014063 |
| 148.2930 | 99.986 | -0.000862 | 148.2080 | 99.957 | 0.003644 | 148.2980 | 99.839 | 0.009107 |
| 149.3150 | 99.984 | 0.004079 | 149.2310 | 99.952 | 0.007777 | 149.3100 | 99.833 | -0.000860 |
| 150.3270 | 99.980 | -0.000955 | 150.2460 | 99.950 | 0.003735 | 150.3170 | 99.832 | 0.003925 |
| 151.3410 | 99.980 | 0.009002 | 151.2400 | 99.947 | 0.003152 | 151.3370 | 99.826 | 0.008561 |
| 152.3610 | 99.976 | 0.009265 | 152.2610 | 99.943 | 0.008354 | 152.3520 | 99.816 | 0.004066 |
| 153.3760 | 99.971 | 0.003936 | 153.2750 | 99.936 | -0.000760 | 153.3670 | 99.811 | 0.003806 |
| 154.3880 | 99.969 | 0.003961 | 154.2950 | 99.935 | 0.003559 | 154.3770 | 99.806 | 0.008464 |
| 155.4030 | 99.964 | 0.004029 | 155.3050 | 99.934 | -0.000770 | 155.4030 | 99.796 | 0.004234 |
| 156.4210 | 99.961 | -0.000845 | 156.3250 | 99.928 | 0.008217 | 156.4210 | 99.789 | 0.004141 |
| 157.4470 | 99.960 | -0.001118 | 157.3370 | 99.924 | 0.003792 | 157.4300 | 99.785 | 0.003738 |
| 158.4550 | 99.955 | 0.003802 | 158.3650 | 99.922 | 0.003644 | 158.4570 | 99.776 | 0.013497 |
| 159.4790 | 99.952 | 0.003732 | 159.3740 | 99.919 | 0.003559 | 159.4690 | 99.765 | 0.008573 |
| 160.4960 | 99.947 | -0.001098 | 160.4070 | 99.911 | 0.008426 | 160.4980 | 99.759 | -0.001101 |
| 161.5260 | 99.943 | 0.008678 | 161.4210 | 99.907 | -0.000743 | 161.5100 | 99.756 | 0.003655 |
| 162.5530 | 99.935 | -0.000900 | 162.4350 | 99.908 | 0.003538 | 162.5250 | 99.741 | 0.018269 |
| 163.5570 | 99.931 | 0.004220 | 163.4560 | 99.902 | 0.007936 | 163.5400 | 99.736 | -0.000635 |
| 164.5760 | 99.926 | 0.003961 | 164.4660 | 99.892 | 0.012320 | 164.5670 | 99.733 | 0.008697 |
| 165.6030 | 99.923 | 0.008978 | 165.4920 | 99.887 | -0.000614 | 165.5850 | 99.722 | 0.013040 |

Table C-3: Continued

| 1wt% MMT in Linear PMMA (10C/min) | | | 3wt% MMT in Lineard PMMA (10C/min) | | | 5wt% MMT in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 166.6170 | 99.915 | 0.008562 | 166.5040 | 99.885 | 0.003682 | 166.6040 | 99.710 | 0.008486 |
| 167.6440 | 99.910 | 0.008711 | 167.5260 | 99.877 | 0.008045 | 167.6350 | 99.705 | 0.008838 |
| 168.6620 | 99.903 | 0.013466 | 168.5460 | 99.871 | -0.000927 | 168.6560 | 99.696 | 0.013820 |
| 169.6930 | 99.895 | 0.003961 | 169.5690 | 99.869 | 0.003518 | 169.6640 | 99.681 | 0.008489 |
| 170.7070 | 99.891 | 0.013208 | 170.6020 | 99.862 | 0.017080 | 170.6950 | 99.675 | -0.000937 |
| 171.7270 | 99.883 | 0.008306 | 171.6190 | 99.849 | 0.003664 | 171.7300 | 99.668 | 0.013916 |
| 172.7560 | 99.875 | 0.008468 | 172.6480 | 99.844 | 0.003799 | 172.7390 | 99.653 | 0.013040 |
| 173.7830 | 99.867 | 0.008584 | 173.6700 | 99.843 | 0.003623 | 173.7610 | 99.642 | 0.008606 |
| 174.8020 | 99.857 | 0.008426 | 174.6820 | 99.832 | 0.007836 | 174.7910 | 99.632 | 0.009018 |
| 175.8310 | 99.846 | 0.008484 | 175.7100 | 99.825 | 0.003731 | 175.8080 | 99.622 | 0.008752 |
| 176.8590 | 99.840 | 0.004254 | 176.7300 | 99.821 | 0.003601 | 176.8380 | 99.610 | 0.013478 |
| 177.8830 | 99.829 | 0.008455 | 177.7620 | 99.813 | 0.012153 | 177.8630 | 99.600 | 0.008526 |
| 178.9040 | 99.820 | 0.008790 | 178.7780 | 99.799 | 0.007465 | 178.8940 | 99.591 | 0.013442 |
| 179.9390 | 99.807 | 0.014153 | 179.8070 | 99.793 | -0.000939 | 179.9170 | 99.575 | 0.013856 |
| 180.9620 | 99.796 | 0.008652 | 180.8320 | 99.790 | 0.007765 | 180.9350 | 99.564 | 0.004041 |
| 181.9880 | 99.788 | 0.013554 | 181.8550 | 99.781 | 0.011742 | 181.9640 | 99.557 | 0.013279 |
| 183.0190 | 99.777 | 0.009153 | 182.8770 | 99.770 | -0.000649 | 182.9880 | 99.542 | 0.013613 |
| 184.0340 | 99.767 | 0.008953 | 183.9000 | 99.767 | 0.007653 | 184.0080 | 99.529 | 0.013446 |
| 185.0510 | 99.756 | 0.008189 | 184.9290 | 99.756 | 0.008129 | 185.0410 | 99.519 | 0.008896 |
| 186.0930 | 99.747 | 0.014009 | 185.9460 | 99.743 | 0.007864 | 186.0590 | 99.506 | 0.013396 |
| 187.1070 | 99.733 | 0.008510 | 186.9770 | 99.739 | -0.000738 | 187.0940 | 99.493 | 0.009443 |
| 188.1250 | 99.726 | 0.008351 | 188.0020 | 99.734 | 0.012374 | 188.1180 | 99.479 | 0.009261 |
| 189.1670 | 99.713 | 0.013643 | 189.0190 | 99.722 | 0.012199 | 189.1380 | 99.470 | 0.017809 |
| 190.1910 | 99.701 | 0.003769 | 190.0450 | 99.710 | 0.003379 | 190.1660 | 99.454 | 0.008484 |
| 191.2100 | 99.688 | 0.014239 | 191.0660 | 99.702 | 0.003458 | 191.1920 | 99.438 | 0.013613 |
| 192.2420 | 99.676 | 0.013924 | 192.1040 | 99.695 | 0.012447 | 192.2200 | 99.428 | 0.004020 |
| 193.2640 | 99.665 | 0.013724 | 193.1260 | 99.682 | 0.012577 | 193.2400 | 99.415 | 0.013600 |
| 194.2880 | 99.654 | 0.008669 | 194.1530 | 99.675 | 0.003752 | 194.2590 | 99.399 | 0.018697 |
| 195.3150 | 99.643 | 0.013772 | 195.1810 | 99.668 | 0.012630 | 195.2980 | 99.385 | 0.013973 |
| 196.3330 | 99.628 | 0.013853 | 196.1920 | 99.655 | 0.016558 | 196.3180 | 99.372 | 0.024302 |
| 197.3530 | 99.618 | 0.008884 | 197.2150 | 99.642 | 0.007615 | 197.3350 | 99.351 | 0.013378 |
| 198.3840 | 99.605 | 0.013841 | 198.2510 | 99.637 | 0.013152 | 198.3690 | 99.339 | 0.013556 |
| 199.4060 | 99.588 | 0.013900 | 199.2680 | 99.623 | 0.011990 | 199.3890 | 99.326 | 0.013378 |
| 200.4330 | 99.572 | 0.013679 | 200.2950 | 99.609 | 0.008238 | 200.4140 | 99.308 | 0.023391 |
| 201.4610 | 99.560 | 0.014191 | 201.3220 | 99.601 | 0.007508 | 201.4420 | 99.289 | 0.018593 |
| 202.4860 | 99.543 | 0.013461 | 202.3460 | 99.589 | 0.012280 | 202.4680 | 99.273 | 0.013114 |
| 203.5160 | 99.529 | 0.008832 | 203.3780 | 99.575 | 0.012310 | 203.4980 | 99.258 | 0.022962 |
| 204.5460 | 99.513 | 0.019751 | 204.4080 | 99.561 | 0.012268 | 204.5370 | 99.234 | 0.024075 |
| 205.5710 | 99.495 | 0.013830 | 205.4370 | 99.549 | 0.008095 | 205.5580 | 99.216 | 0.018091 |
| 206.6050 | 99.480 | 0.018097 | 206.4650 | 99.535 | 0.011652 | 206.5820 | 99.199 | 0.017832 |
| 207.6370 | 99.463 | 0.019013 | 207.4970 | 99.519 | 0.016886 | 207.6200 | 99.167 | 0.033019 |
| 208.6620 | 99.443 | 0.018643 | 208.5150 | 99.507 | 0.007424 | 208.6470 | 99.139 | 0.022858 |
| 209.6920 | 99.422 | 0.022675 | 209.5490 | 99.493 | 0.020024 | 209.6770 | 99.115 | 0.023135 |
| 210.7230 | 99.400 | 0.024497 | 210.5740 | 99.475 | 0.016063 | 210.7080 | 99.084 | 0.037485 |
| 211.7590 | 99.380 | 0.018994 | 211.6090 | 99.459 | 0.012175 | 211.7350 | 99.048 | 0.036244 |
| 212.7770 | 99.359 | 0.018090 | 212.6440 | 99.444 | 0.020980 | 212.7650 | 99.015 | 0.027853 |
| 213.8090 | 99.333 | 0.017225 | 213.6730 | 99.425 | 0.012522 | 213.7970 | 98.980 | 0.036963 |
| 214.8470 | 99.313 | 0.023096 | 214.7000 | 99.408 | 0.020860 | 214.8280 | 98.942 | 0.032833 |
| 215.8740 | 99.286 | 0.023535 | 215.7280 | 99.391 | 0.012374 | 215.8660 | 98.913 | 0.029695 |
| 216.8990 | 99.259 | 0.027240 | 216.7630 | 99.373 | 0.021336 | 216.8960 | 98.881 | 0.037347 |
| 217.9360 | 99.231 | 0.026607 | 217.7860 | 99.352 | 0.021045 | 217.9190 | 98.838 | 0.041702 |
| 218.9710 | 99.202 | 0.030088 | 218.8220 | 99.333 | 0.016174 | 218.9540 | 98.793 | 0.041283 |
| 219.9920 | 99.173 | 0.032884 | 219.8530 | 99.318 | 0.016982 | 219.9800 | 98.756 | 0.037810 |
| 221.0190 | 99.139 | 0.027827 | 220.8780 | 99.294 | 0.024719 | 221.0200 | 98.721 | 0.032305 |
| 222.0540 | 99.108 | 0.028684 | 221.9230 | 99.274 | 0.016668 | 222.0410 | 98.680 | 0.037108 |
| 223.0860 | 99.077 | 0.037825 | 222.9440 | 99.255 | 0.016647 | 223.0720 | 98.647 | 0.032328 |
| 224.1160 | 99.039 | 0.032601 | 223.9760 | 99.234 | 0.035633 | 224.1090 | 98.611 | 0.031759 |
| 225.1440 | 99.005 | 0.033320 | 225.0000 | 99.208 | 0.016385 | 225.1360 | 98.576 | 0.038080 |
| 226.1730 | 98.968 | 0.043363 | 226.0340 | 99.189 | 0.016626 | 226.1610 | 98.536 | 0.037439 |
| 227.2100 | 98.929 | 0.024802 | 227.0720 | 99.171 | 0.021614 | 227.1940 | 98.503 | 0.031425 |
| 228.2400 | 98.900 | 0.071549 | 228.0930 | 99.147 | 0.024535 | 228.2290 | 98.468 | 0.033435 |
| 229.2680 | 98.830 | 0.063669 | 229.1330 | 99.122 | 0.025817 | 229.2480 | 98.427 | 0.040708 |
| 230.3040 | 98.775 | 0.053682 | 230.1590 | 99.100 | 0.021272 | 230.2910 | 98.388 | 0.032332 |
| 231.3270 | 98.747 | 0.023510 | 231.1850 | 99.075 | 0.030384 | 231.3140 | 98.356 | 0.038034 |
| 232.3570 | 98.660 | 0.131542 | 232.2180 | 99.046 | 0.025896 | 232.3510 | 98.318 | 0.037450 |
| 233.3860 | 98.543 | 0.090296 | 233.2430 | 99.024 | 0.020743 | 233.3780 | 98.278 | 0.041953 |

Table C-3: Continued

| 1wt% MMT in Linear PMMA (10C/min) | | | 3wt% MMT in Lineard PMMA (10C/min) | | | 5wt% MMT in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 234.4190 | 98.463 | 0.068646 | 234.2710 | 99.002 | 0.029124 | 234.4150 | 98.237 | 0.032008 |
| 235.4390 | 98.398 | 0.065086 | 235.3070 | 98.970 | 0.028911 | 235.4340 | 98.199 | 0.042352 |
| 236.4680 | 98.330 | 0.061656 | 236.3310 | 98.942 | 0.030003 | 236.4770 | 98.155 | 0.038448 |
| 237.5120 | 98.267 | 0.062171 | 237.3620 | 98.913 | 0.030277 | 237.4960 | 98.117 | 0.037347 |
| 238.5320 | 98.206 | 0.063217 | 238.3990 | 98.882 | 0.034326 | 238.5250 | 98.077 | 0.040642 |
| 239.5640 | 98.144 | 0.058771 | 239.4230 | 98.848 | 0.029562 | 239.5630 | 98.032 | 0.047531 |
| 240.5940 | 98.080 | 0.060440 | 240.4460 | 98.822 | 0.020325 | 240.5830 | 97.987 | 0.043178 |
| 241.6220 | 98.017 | 0.055409 | 241.4760 | 98.894 | 0.398196 | 241.6070 | 97.943 | 0.050850 |
| 242.6540 | 97.960 | 0.061877 | 242.5050 | 98.673 | 0.087319 | 242.6380 | 97.892 | 0.057206 |
| 243.6890 | 97.901 | 0.051879 | 243.5360 | 98.609 | 0.047247 | 243.6800 | 97.826 | 0.060922 |
| 244.7100 | 97.845 | 0.054503 | 244.5710 | 98.561 | 0.047632 | 244.7010 | 97.769 | 0.049735 |
| 245.7350 | 97.784 | 0.059917 | 245.5950 | 98.511 | 0.049667 | 245.7360 | 97.715 | 0.053416 |
| 246.7700 | 97.725 | 0.053921 | 246.6300 | 98.474 | -0.240617 | 246.7660 | 97.658 | 0.056655 |
| 247.7970 | 97.665 | 0.057365 | 247.6520 | 98.400 | 0.222451 | 247.7970 | 97.604 | 0.041689 |
| 248.8250 | 97.603 | 0.066563 | 248.6850 | 98.270 | 0.087319 | 248.8300 | 97.554 | 0.060633 |
| 249.8530 | 97.535 | 0.063383 | 249.7120 | 98.179 | 0.068458 | 249.8630 | 97.497 | 0.060428 |
| 250.8810 | 97.467 | 0.071248 | 250.7290 | 98.115 | 0.052839 | 250.8780 | 97.437 | 0.050718 |
| 251.9200 | 97.388 | 0.077301 | 251.7660 | 98.055 | 0.054600 | 251.9010 | 97.387 | 0.045439 |
| 252.9500 | 97.319 | 0.069524 | 252.7940 | 98.003 | 0.050651 | 252.9330 | 97.331 | 0.055868 |
| 253.9760 | 97.250 | 0.077690 | 253.8200 | 97.947 | 0.054682 | 253.9590 | 97.270 | 0.059567 |
| 255.0040 | 97.163 | 0.085953 | 254.8530 | 97.893 | 0.054620 | 254.9840 | 97.211 | 0.055211 |
| 256.0250 | 97.079 | 0.069674 | 255.8890 | 97.836 | 0.052999 | 256.0230 | 97.154 | 0.056724 |
| 257.0600 | 97.001 | 0.072443 | 256.9050 | 97.778 | 0.054813 | 257.0510 | 97.092 | 0.069399 |
| 258.0820 | 96.922 | 0.078423 | 257.9380 | 97.721 | 0.054369 | 258.0730 | 97.027 | 0.060967 |
| 259.1080 | 96.829 | 0.101705 | 258.9600 | 97.667 | 0.053453 | 259.1010 | 96.963 | 0.066080 |
| 260.1450 | 96.718 | 0.104685 | 259.9890 | 97.609 | 0.057903 | 260.1300 | 96.894 | 0.071298 |
| 261.1640 | 96.620 | 0.087588 | 261.0230 | 97.545 | 0.062558 | 261.1560 | 96.812 | 0.079363 |
| 262.1890 | 96.531 | 0.083714 | 262.0440 | 97.488 | 0.060666 | 262.1860 | 96.737 | 0.064030 |
| 263.2180 | 96.441 | 0.085545 | 263.0780 | 97.422 | 0.060580 | 263.2160 | 96.665 | 0.073053 |
| 264.2480 | 96.351 | 0.085223 | 264.1020 | 97.358 | 0.059044 | 264.2420 | 96.588 | 0.083068 |
| 265.2750 | 96.259 | 0.087111 | 265.1320 | 97.280 | 0.108178 | 265.2560 | 96.510 | 0.075319 |
| 266.3030 | 96.166 | 0.089281 | 266.1580 | 97.170 | 0.102683 | 266.2930 | 96.436 | 0.069691 |
| 267.3290 | 96.074 | 0.083830 | 267.1820 | 97.073 | 0.093602 | 267.3180 | 96.360 | 0.071091 |
| 268.3530 | 95.981 | 0.084891 | 268.2090 | 96.974 | 0.095170 | 268.3390 | 96.282 | 0.073004 |
| 269.3790 | 95.886 | 0.093583 | 269.2300 | 96.887 | 0.074594 | 269.3730 | 96.204 | 0.069691 |
| 270.4080 | 95.792 | 0.100357 | 270.2590 | 96.802 | 0.090341 | 270.3910 | 96.128 | 0.072192 |
| 271.4290 | 95.693 | 0.098553 | 271.2810 | 96.710 | 0.087593 | 271.4250 | 96.046 | 0.087803 |
| 272.4570 | 95.597 | 0.096024 | 272.3130 | 96.623 | 0.083606 | 272.4530 | 95.959 | 0.080262 |
| 273.4910 | 95.496 | 0.097191 | 273.3370 | 96.543 | 0.079432 | 273.4820 | 95.883 | 0.077765 |
| 274.5130 | 95.396 | 0.100831 | 274.3690 | 96.458 | 0.086855 | 274.5020 | 95.798 | 0.083541 |
| 275.5310 | 95.297 | 0.093281 | 275.3930 | 96.371 | 0.085902 | 275.5300 | 95.711 | 0.089305 |
| 276.5590 | 95.197 | 0.099773 | 276.4090 | 96.284 | 0.086303 | 276.5530 | 95.620 | 0.084250 |
| 277.5820 | 95.093 | 0.099773 | 277.4460 | 96.193 | 0.093497 | 277.5740 | 95.539 | 0.086623 |
| 278.5970 | 94.995 | 0.090954 | 278.4760 | 96.104 | 0.091105 | 278.6060 | 95.450 | 0.087350 |
| 279.6270 | 94.897 | 0.098535 | 279.4930 | 96.019 | 0.076763 | 279.6270 | 95.364 | 0.084529 |
| 280.6610 | 94.799 | 0.099198 | 280.5130 | 95.938 | 0.076297 | 280.6480 | 95.277 | 0.080515 |
| 281.6880 | 94.705 | 0.092351 | 281.5400 | 95.850 | 0.083980 | 281.6740 | 95.188 | 0.093074 |
| 282.7090 | 94.616 | 0.090296 | 282.5610 | 95.764 | 0.075901 | 282.7020 | 95.093 | 0.091067 |
| 283.7410 | 94.526 | 0.082112 | 283.5900 | 95.688 | 0.077477 | 283.7240 | 95.004 | 0.079958 |
| 284.7600 | 94.445 | 0.072894 | 284.6250 | 95.606 | 0.085571 | 284.7560 | 94.918 | 0.084689 |
| 285.7870 | 94.362 | 0.080657 | 285.6370 | 95.525 | 0.076024 | 285.7740 | 94.824 | 0.095858 |
| 286.8270 | 94.283 | 0.075475 | 286.6640 | 95.447 | 0.073823 | 286.7980 | 94.731 | 0.081417 |
| 287.8430 | 94.207 | 0.071503 | 287.6890 | 95.372 | 0.078294 | 287.8300 | 94.642 | 0.089361 |
| 288.8750 | 94.137 | 0.071263 | 288.7150 | 95.290 | 0.081045 | 288.8540 | 94.549 | 0.091583 |
| 289.9030 | 94.068 | 0.069404 | 289.7280 | 95.215 | 0.074750 | 289.8780 | 94.453 | 0.088838 |
| 290.9230 | 94.001 | 0.062241 | 290.7650 | 95.144 | 0.077624 | 290.9080 | 94.363 | 0.092151 |
| 291.9530 | 93.936 | 0.069597 | 291.7740 | 95.068 | 0.072116 | 291.9250 | 94.270 | 0.097093 |
| 292.9710 | 93.872 | 0.061024 | 292.8090 | 94.996 | 0.074644 | 292.9500 | 94.170 | 0.097486 |
| 294.0000 | 93.811 | 0.057728 | 293.8310 | 94.927 | 0.064077 | 293.9760 | 94.073 | 0.091606 |
| 295.0200 | 93.749 | 0.057611 | 294.8500 | 94.865 | 0.063629 | 294.9940 | 93.985 | 0.096355 |
| 296.0500 | 93.690 | 0.058119 | 295.8740 | 94.799 | 0.064501 | 296.0200 | 93.886 | 0.094835 |
| 297.0660 | 93.631 | 0.058189 | 296.9030 | 94.739 | 0.055297 | 297.0480 | 93.792 | 0.101388 |
| 298.0920 | 93.572 | 0.061185 | 297.9330 | 94.684 | 0.050589 | 298.0710 | 93.698 | 0.092727 |
| 299.1200 | 93.516 | 0.054104 | 298.9500 | 94.626 | 0.065809 | 299.0890 | 93.602 | 0.098403 |
| 300.1410 | 93.463 | 0.057954 | 299.9670 | 94.568 | 0.048874 | 300.1150 | 93.502 | 0.095228 |

Table C-3: Continued

| 1wt% MMT in Linear PMMA (10C/min) | | | 3wt% MMT in Lineard PMMA (10C/min) | | | 5wt% MMT in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 301.1680 | 93.406 | 0.058867 | 300.9930 | 94.518 | 0.051202 | 301.1360 | 93.412 | 0.088403 |
| 302.1920 | 93.348 | 0.055186 | 302.0170 | 94.463 | 0.055843 | 302.1600 | 93.322 | 0.098287 |
| 303.2210 | 93.293 | 0.048302 | 303.0440 | 94.407 | 0.051285 | 303.1800 | 93.222 | 0.093473 |
| 304.2450 | 93.236 | 0.058284 | 304.0640 | 94.359 | 0.046804 | 304.2080 | 93.129 | 0.092916 |
| 305.2610 | 93.178 | 0.053479 | 305.0950 | 94.307 | 0.065560 | 305.2230 | 93.035 | 0.094789 |
| 306.2790 | 93.121 | 0.061208 | 306.1140 | 94.251 | 0.057864 | 306.2460 | 92.939 | 0.098471 |
| 307.3020 | 93.056 | 0.051762 | 307.1230 | 94.192 | 0.053838 | 307.2730 | 92.839 | 0.092292 |
| 308.3210 | 92.997 | 0.064501 | 308.1600 | 94.136 | 0.055683 | 308.2940 | 92.745 | 0.099611 |
| 309.3400 | 92.930 | 0.067072 | 309.1820 | 94.075 | 0.059365 | 309.3020 | 92.645 | 0.103515 |
| 310.3600 | 92.860 | 0.066586 | 310.1990 | 94.010 | 0.067928 | 310.3290 | 92.538 | 0.100723 |
| 311.3810 | 92.787 | 0.070247 | 311.2210 | 93.948 | 0.059669 | 311.3510 | 92.435 | 0.099525 |
| 312.4020 | 92.713 | 0.080145 | 312.2410 | 93.878 | 0.078527 | 312.3730 | 92.331 | 0.100649 |
| 313.4280 | 92.629 | 0.086069 | 313.2630 | 93.801 | 0.079082 | 313.3930 | 92.221 | 0.107330 |
| 314.4500 | 92.542 | 0.086092 | 314.2790 | 93.724 | 0.073263 | 314.4120 | 92.107 | 0.115347 |
| 315.4610 | 92.449 | 0.094428 | 315.3000 | 93.646 | 0.087373 | 315.4330 | 91.989 | 0.109018 |
| 316.4860 | 92.349 | 0.111862 | 316.3210 | 93.555 | 0.081568 | 316.4530 | 91.870 | 0.127963 |
| 317.4990 | 92.238 | 0.115293 | 317.3400 | 93.466 | 0.091679 | 317.4700 | 91.738 | 0.130115 |
| 318.5160 | 92.119 | 0.110337 | 318.3630 | 93.373 | 0.096710 | 318.4900 | 91.612 | 0.127844 |
| 319.5310 | 91.992 | 0.128371 | 319.3780 | 93.267 | 0.102234 | 319.5060 | 91.479 | 0.131334 |
| 320.5490 | 91.860 | 0.136594 | 320.3880 | 93.159 | 0.108470 | 320.5180 | 91.339 | 0.145642 |
| 321.5700 | 91.714 | 0.141954 | 321.4110 | 93.045 | 0.106313 | 321.5390 | 91.189 | 0.141662 |
| 322.5870 | 91.557 | 0.160216 | 322.4380 | 92.931 | 0.124257 | 322.5610 | 91.041 | 0.153610 |
| 323.6060 | 91.387 | 0.170704 | 323.4510 | 92.802 | 0.127044 | 323.5810 | 90.884 | 0.157520 |
| 324.6170 | 91.207 | 0.176078 | 324.4680 | 92.667 | 0.139638 | 324.5970 | 90.719 | 0.166331 |
| 325.6440 | 91.015 | 0.197900 | 325.4950 | 92.531 | 0.139449 | 325.6180 | 90.554 | 0.165552 |
| 326.6510 | 90.813 | 0.209008 | 326.5050 | 92.387 | 0.149182 | 326.6300 | 90.380 | 0.181861 |
| 327.6720 | 90.595 | 0.218748 | 327.5200 | 92.232 | 0.167561 | 327.6520 | 90.196 | 0.191118 |
| 328.6840 | 90.367 | 0.243179 | 328.5360 | 92.070 | 0.157907 | 328.6670 | 90.007 | 0.187339 |
| 329.6890 | 90.120 | 0.240727 | 329.5560 | 91.905 | 0.184290 | 329.6790 | 89.821 | 0.192396 |
| 330.7150 | 89.861 | 0.265851 | 330.5700 | 91.725 | 0.184423 | 330.7000 | 89.620 | 0.214695 |
| 331.7250 | 89.585 | 0.274030 | 331.5830 | 91.540 | 0.194512 | 331.7210 | 89.411 | 0.222324 |
| 332.7390 | 89.285 | 0.324989 | 332.5980 | 91.340 | 0.203009 | 332.7330 | 89.186 | 0.245166 |
| 333.7430 | 88.955 | 0.332045 | 333.6190 | 91.127 | 0.219160 | 333.7480 | 88.944 | 0.246833 |
| 334.7600 | 88.602 | 0.366824 | 334.6290 | 90.907 | 0.232854 | 334.7640 | 88.697 | 0.239547 |
| 335.7710 | 88.225 | 0.371461 | 335.6460 | 90.672 | 0.244697 | 335.7810 | 88.446 | 0.261552 |
| 336.7800 | 87.820 | 0.411602 | 336.6660 | 90.431 | 0.253629 | 336.7900 | 88.183 | 0.276462 |
| 337.7990 | 87.371 | 0.469020 | 337.6850 | 90.168 | 0.282400 | 337.8070 | 87.907 | 0.279731 |
| 338.8140 | 86.896 | 0.519794 | 338.6960 | 89.891 | 0.294722 | 338.8220 | 87.619 | 0.301755 |
| 339.8190 | 86.386 | 0.530730 | 339.6960 | 89.595 | 0.291578 | 339.8320 | 87.322 | 0.300680 |
| 340.8250 | 85.846 | 0.555793 | 340.7200 | 89.277 | 0.335782 | 340.8490 | 87.009 | 0.327101 |
| 341.8320 | 85.274 | 0.578617 | 341.7240 | 88.935 | 0.337184 | 341.8610 | 86.675 | 0.327185 |
| 342.8420 | 84.663 | 0.640303 | 342.7360 | 88.578 | 0.356897 | 342.8780 | 86.326 | 0.358048 |
| 343.8450 | 84.000 | 0.668702 | 343.7460 | 88.193 | 0.376091 | 343.8830 | 85.915 | 0.461881 |
| 344.8580 | 83.306 | 0.706268 | 344.7600 | 87.778 | 0.435767 | 344.8970 | 85.444 | 0.445999 |
| 345.8650 | 82.567 | 0.784299 | 345.7720 | 87.340 | 0.471401 | 345.9140 | 84.988 | 0.472154 |
| 346.8720 | 81.769 | 0.814159 | 346.7730 | 86.870 | 0.480137 | 346.9130 | 84.531 | 0.461881 |
| 347.8690 | 80.922 | 0.870779 | 347.7770 | 86.365 | 0.515021 | 347.9200 | 84.048 | 0.495436 |
| 348.8760 | 80.049 | 0.887132 | 348.7840 | 85.825 | 0.544318 | 348.9330 | 83.534 | 0.508832 |
| 349.8830 | 79.150 | 0.903992 | 349.7940 | 85.256 | 0.604825 | 349.9450 | 82.985 | 0.608509 |
| 350.8830 | 78.182 | 1.023494 | 350.8020 | 84.646 | 0.673925 | 350.9480 | 82.351 | 0.667416 |
| 351.8820 | 77.164 | 1.039804 | 351.8040 | 83.987 | 0.695698 | 351.9560 | 81.628 | 0.747887 |
| 352.8810 | 76.108 | 1.049341 | 352.8020 | 83.279 | 0.731605 | 352.9600 | 80.889 | 0.725640 |
| 353.8870 | 75.004 | 1.137687 | 353.8070 | 82.524 | 0.803240 | 353.9750 | 80.176 | 0.725083 |
| 354.8810 | 73.853 | 1.145966 | 354.7980 | 81.714 | 0.813312 | 354.9820 | 79.442 | 0.794656 |
| 355.8890 | 72.661 | 1.268470 | 355.8150 | 80.851 | 0.887669 | 355.9790 | 78.670 | 0.775070 |
| 356.8810 | 71.415 | 1.193617 | 356.8180 | 79.953 | 0.968775 | 356.9820 | 77.872 | 0.808689 |
| 357.8880 | 70.128 | 1.304051 | 357.8120 | 79.001 | 1.039616 | 357.9890 | 77.029 | 0.867008 |
| 358.8840 | 68.802 | 1.332698 | 358.8090 | 77.985 | 1.036095 | 358.9960 | 76.113 | 0.927349 |
| 359.8880 | 67.445 | 1.438381 | 359.8040 | 76.931 | 1.056535 | 359.9970 | 75.157 | 0.987303 |
| 360.8910 | 66.037 | 1.449185 | 360.8040 | 75.837 | 1.149649 | 360.9970 | 74.163 | 1.028912 |
| 361.8790 | 64.583 | 1.487926 | 361.8000 | 74.691 | 1.205918 | 362.0010 | 73.120 | 1.110917 |
| 362.8730 | 63.091 | 1.461512 | 362.8040 | 73.478 | 1.252521 | 363.0000 | 72.017 | 1.139955 |
| 363.8740 | 61.567 | 1.503102 | 363.8010 | 72.220 | 1.292928 | 363.9950 | 70.860 | 1.141169 |
| 364.8790 | 60.010 | 1.562668 | 364.7920 | 70.920 | 1.375011 | 365.0020 | 69.686 | 1.227997 |
| 365.8820 | 58.434 | 1.541155 | 365.7800 | 69.577 | 1.357591 | 365.9960 | 68.513 | 1.140852 |

Table C-3: Continued

| 1wt% MMT in Linear PMMA (10C/min) | | | 3wt% MMT in Lineard PMMA (10C/min) | | | 5wt% MMT in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 366.8800 | 56.839 | 1.619796 | 366.7840 | 68.181 | 1.407548 | 367.0020 | 67.324 | 1.217613 |
| 367.8790 | 55.223 | 1.626722 | 367.7720 | 66.754 | 1.528033 | 367.9950 | 66.068 | 1.293951 |
| 368.8830 | 53.573 | 1.648702 | 368.7780 | 65.281 | 1.572061 | 368.9980 | 64.751 | 1.372338 |
| 369.8860 | 51.904 | 1.634641 | 369.7740 | 63.774 | 1.530845 | 369.9960 | 63.408 | 1.356761 |
| 370.8850 | 50.221 | 1.632388 | 370.7750 | 62.227 | 1.562862 | 371.0020 | 62.032 | 1.454266 |
| 371.8810 | 48.513 | 1.719522 | 371.7700 | 60.635 | 1.713264 | 371.9990 | 60.605 | 1.476084 |
| 372.8860 | 46.765 | 1.823621 | 372.7680 | 59.003 | 1.655422 | 372.9960 | 59.153 | 1.444816 |
| 373.8790 | 45.004 | 1.730889 | 373.7710 | 57.373 | 1.612047 | 373.9980 | 57.630 | 1.524406 |
| 374.8840 | 43.235 | 1.759493 | 374.7770 | 55.721 | 1.697823 | 374.9980 | 56.080 | 1.584700 |
| 375.8950 | 41.454 | 1.866301 | 375.7670 | 54.036 | 1.709011 | 375.9980 | 54.543 | 1.577358 |
| 376.8980 | 39.673 | 1.719031 | 376.7570 | 52.326 | 1.775782 | 376.9890 | 53.031 | 1.516737 |
| 377.9070 | 37.905 | 1.794407 | 377.7470 | 50.570 | 1.716562 | 377.9880 | 51.461 | 1.574226 |
| 378.9190 | 36.129 | 1.777885 | 378.7390 | 48.779 | 1.789099 | 378.9910 | 49.847 | 1.559146 |
| 379.9310 | 34.372 | 1.708448 | 379.7440 | 46.950 | 1.987681 | 379.9970 | 48.229 | 1.611625 |
| 380.9450 | 32.647 | 1.775263 | 380.7290 | 45.080 | 1.914287 | 381.0070 | 46.611 | 1.628884 |
| 381.9570 | 30.928 | 1.624733 | 381.7220 | 43.180 | 1.960095 | 382.0200 | 44.992 | 1.534199 |
| 382.9680 | 29.244 | 1.576993 | 382.7270 | 41.259 | 1.926990 | 383.0330 | 43.374 | 1.527278 |
| 383.9780 | 27.590 | 1.593716 | 383.7180 | 39.339 | 1.868891 | 384.0470 | 41.778 | 1.529701 |
| 384.9830 | 25.941 | 1.607732 | 384.7230 | 37.433 | 1.886937 | 385.0630 | 40.195 | 1.620347 |
| 385.9960 | 24.337 | 1.538277 | 385.7340 | 35.550 | 1.870556 | 386.0840 | 38.624 | 1.568989 |
| 387.0230 | 22.764 | 1.472595 | 386.7430 | 33.690 | 1.771893 | 387.1010 | 37.072 | 1.507445 |
| 388.0430 | 21.247 | 1.403051 | 387.7590 | 31.853 | 1.754591 | 388.1170 | 35.550 | 1.517516 |
| 389.0680 | 19.800 | 1.363047 | 388.7880 | 30.069 | 1.744345 | 389.1350 | 34.045 | 1.411202 |
| 390.1000 | 18.437 | 1.255755 | 389.8100 | 28.326 | 1.746122 | 390.1640 | 32.563 | 1.411316 |
| 391.1260 | 17.140 | 1.141000 | 390.8240 | 26.633 | 1.618609 | 391.1840 | 31.114 | 1.376652 |
| 392.1690 | 15.926 | 1.121216 | 391.8520 | 24.998 | 1.583135 | 392.2140 | 29.702 | 1.363566 |
| 393.1960 | 14.780 | 1.021100 | 392.8740 | 23.415 | 1.502081 | 393.2380 | 28.310 | 1.354283 |
| 394.2290 | 13.705 | 1.004470 | 393.9020 | 21.883 | 1.437507 | 394.2700 | 26.953 | 1.335658 |
| 395.2620 | 12.695 | 0.915057 | 394.9390 | 20.410 | 1.444187 | 395.2870 | 25.634 | 1.247446 |
| 396.3080 | 11.747 | 0.915909 | 395.9620 | 19.005 | 1.334328 | 396.3230 | 24.341 | 1.298803 |
| 397.3300 | 10.856 | 0.829410 | 396.9930 | 17.655 | 1.231094 | 397.3420 | 23.071 | 1.178426 |
| 398.3610 | 10.019 | 0.770902 | 398.0360 | 16.382 | 1.216861 | 398.3680 | 21.843 | 1.177386 |
| 399.4030 | 9.255 | 0.694517 | 399.0700 | 15.184 | 1.085207 | 399.3910 | 20.652 | 1.129074 |
| 400.4430 | 8.572 | 0.610374 | 400.1070 | 14.065 | 1.027007 | 400.4210 | 19.499 | 1.097730 |
| 401.4890 | 7.976 | 0.535833 | 401.1480 | 13.019 | 0.923207 | 401.4520 | 18.389 | 1.023343 |
| 402.5290 | 7.475 | 0.438900 | 402.1850 | 12.064 | 0.853631 | 402.4820 | 17.338 | 1.016893 |
| 403.5690 | 7.056 | 0.365938 | 403.2340 | 11.189 | 0.783664 | 403.5150 | 16.348 | 0.933760 |
| 404.6110 | 6.718 | 0.278799 | 404.2870 | 10.405 | 0.688476 | 404.5450 | 15.419 | 0.830281 |
| 405.6520 | 6.449 | 0.227779 | 405.3400 | 9.705 | 0.619564 | 405.5820 | 14.579 | 0.735236 |
| 406.6900 | 6.250 | 0.138445 | 406.3880 | 9.103 | 0.537404 | 406.6240 | 13.830 | 0.632164 |
| 407.7280 | 6.121 | 0.096007 | 407.4340 | 8.593 | 0.446086 | 407.6740 | 13.214 | 0.526877 |
| 408.7700 | 6.048 | 0.037203 | 408.4820 | 8.175 | 0.355991 | 408.7220 | 12.737 | 0.328049 |
| 409.8040 | 6.012 | 0.018915 | 409.5300 | 7.854 | 0.257889 | 409.7760 | 12.428 | 0.234921 |
| 410.8300 | 6.001 | 0.010701 | 410.5840 | 7.630 | 0.173721 | 410.8320 | 12.233 | 0.116629 |
| 411.8680 | 5.989 | 0.006888 | 411.6260 | 7.484 | 0.103144 | 411.8680 | 12.123 | 0.079049 |
| 412.8920 | 5.986 | 0.007318 | 412.6710 | 7.413 | 0.037844 | 412.9070 | 12.059 | 0.043198 |
| 413.9200 | 5.977 | 0.007750 | 413.7070 | 7.381 | 0.024328 | 413.9440 | 12.008 | 0.048275 |
| 414.9420 | 5.972 | 0.002172 | 414.7440 | 7.358 | 0.020777 | 414.9760 | 11.960 | 0.041330 |
| 415.9620 | 5.965 | 0.007664 | 415.7720 | 7.335 | 0.019382 | 415.9960 | 11.920 | 0.036552 |
| 416.9810 | 5.961 | 0.001743 | 416.8110 | 7.318 | 0.009622 | 417.0240 | 11.884 | 0.033672 |
| 418.0020 | 5.954 | 0.005884 | 417.8320 | 7.305 | 0.012342 | 418.0520 | 11.847 | 0.035614 |
| 419.0170 | 5.950 | 0.004634 | 418.8660 | 7.291 | 0.016501 | 419.0740 | 11.811 | 0.029810 |
| 420.0330 | 5.946 | 0.000697 | 419.8890 | 7.273 | 0.010782 | 420.0940 | 11.782 | 0.027831 |
| 421.0500 | 5.943 | 0.013434 | 420.9150 | 7.265 | 0.010658 | 421.1180 | 11.751 | 0.036734 |
| 422.0660 | 5.935 | 0.005005 | 421.9380 | 7.253 | 0.013474 | 422.1370 | 11.716 | 0.031982 |
| 423.0790 | 5.934 | -0.001286 | 422.9520 | 7.237 | 0.015914 | 423.1550 | 11.689 | 0.025390 |
| 424.0940 | 5.930 | 0.008545 | 423.9660 | 7.229 | 0.002599 | 424.1740 | 11.662 | 0.028522 |
| 425.1170 | 5.925 | 0.000355 | 424.9910 | 7.224 | 0.016891 | 425.1900 | 11.635 | 0.029172 |
| 426.1270 | 5.925 | 0.002283 | 426.0040 | 7.210 | 0.012867 | 426.2090 | 11.606 | 0.023457 |
| 427.1360 | 5.921 | 0.005828 | 427.0160 | 7.200 | 0.003395 | 427.2210 | 11.588 | 0.016746 |
| 428.1460 | 5.916 | 0.002453 | 428.0270 | 7.195 | 0.009047 | 428.2320 | 11.568 | 0.024161 |
| 429.1630 | 5.914 | 0.002552 | 429.0470 | 7.184 | 0.011646 | 429.2430 | 11.543 | 0.022416 |
| 430.1720 | 5.911 | -0.001526 | 430.0550 | 7.172 | 0.009551 | 430.2660 | 11.525 | 0.011335 |
| 431.1860 | 5.912 | 0.002666 | 431.0750 | 7.167 | 0.001904 | 431.2730 | 11.510 | 0.018023 |
| 432.1910 | 5.910 | 0.001164 | 432.0800 | 7.164 | 0.004542 | 432.2850 | 11.490 | 0.020175 |
| 433.2090 | 5.907 | 0.003609 | 433.0960 | 7.158 | 0.008666 | 433.2950 | 11.469 | 0.015558 |

Table C-3: Continued

| 1wt% MMT in Linear PMMA (10C/min) | | | 3wt% MMT in Lineard PMMA (10C/min) | | | 5wt% MMT in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 434.2150 | 5.904 | 0.002156 | 434.1050 | 7.148 | 0.002588 | 434.3100 | 11.459 | 0.008044 |
| 435.2290 | 5.901 | -0.000894 | 435.1180 | 7.148 | 0.002435 | 435.3260 | 11.445 | 0.018422 |
| 436.2340 | 5.902 | 0.004687 | 436.1340 | 7.139 | 0.009123 | 436.3350 | 11.427 | 0.011898 |
| 437.2470 | 5.900 | 0.008206 | 437.1380 | 7.131 | 0.008161 | 437.3480 | 11.416 | 0.007040 |
| 438.2500 | 5.894 | -0.006630 | 438.1500 | 7.128 | -0.003845 | 438.3580 | 11.407 | 0.019329 |
| 439.2600 | 5.894 | 0.002165 | 439.1560 | 7.126 | 0.009351 | 439.3670 | 11.391 | 0.015124 |
| 440.2720 | 5.892 | -0.002158 | 440.1640 | 7.115 | 0.005762 | 440.3760 | 11.379 | 0.003926 |
| 441.2800 | 5.893 | 0.001259 | 441.1790 | 7.111 | -0.000813 | 441.3830 | 11.372 | 0.009857 |
| 442.2930 | 5.893 | -0.000146 | 442.1850 | 7.113 | 0.002634 | 442.3900 | 11.362 | 0.009607 |
| 443.2980 | 5.889 | 0.003984 | 443.2010 | 7.106 | 0.007710 | 443.4060 | 11.348 | 0.013119 |
| 444.3130 | 5.887 | -0.000397 | 444.2060 | 7.102 | -0.004088 | 444.4150 | 11.339 | 0.006286 |
| 445.3190 | 5.886 | -0.001244 | 445.2230 | 7.103 | 0.001752 | 445.4150 | 11.334 | 0.004458 |
| 446.3320 | 5.888 | 0.002467 | 446.2270 | 7.097 | 0.010343 | 446.4190 | 11.329 | 0.009234 |
| 447.3330 | 5.884 | 0.004595 | 447.2330 | 7.092 | 0.000927 | 447.4340 | 11.319 | 0.007749 |
| 448.3400 | 5.882 | -0.003775 | 448.2500 | 7.091 | -0.003188 | 448.4380 | 11.313 | 0.004116 |
| 449.3440 | 5.882 | 0.001805 | 449.2490 | 7.092 | 0.002590 | 449.4470 | 11.309 | 0.004090 |
| 450.3620 | 5.881 | -0.001948 | 450.2590 | 7.088 | 0.002725 | 450.4500 | 11.302 | 0.010862 |
| 451.3690 | 5.880 | 0.003864 | 451.2670 | 7.086 | -0.000056 | 451.4660 | 11.293 | 0.004019 |
| 452.3750 | 5.879 | -0.003264 | 452.2760 | 7.085 | 0.003172 | 452.4710 | 11.289 | 0.002026 |
| 453.3860 | 5.880 | 0.004999 | 453.2800 | 7.082 | 0.006686 | 453.4910 | 11.289 | 0.004048 |
| 454.3910 | 5.877 | 0.001016 | 454.3000 | 7.074 | 0.003200 | 454.4860 | 11.282 | 0.006625 |
| 455.4070 | 5.875 | -0.001489 | 455.3040 | 7.073 | -0.002650 | 455.5030 | 11.277 | 0.003972 |
| 456.4080 | 5.876 | -0.001061 | 456.3050 | 7.072 | 0.009337 | 456.5060 | 11.273 | 0.003972 |
| 457.4080 | 5.875 | 0.004597 | 457.3180 | 7.068 | 0.001437 | 457.5170 | 11.267 | 0.009421 |
| 458.4200 | 5.871 | 0.002503 | 458.3210 | 7.067 | 0.002159 | 458.5210 | 11.258 | 0.006702 |
| 459.4330 | 5.870 | 0.000579 | 459.3370 | 7.066 | 0.000378 | 459.5290 | 11.255 | -0.002778 |
| 460.4410 | 5.871 | -0.000193 | 460.3380 | 7.066 | 0.000938 | 460.5400 | 11.258 | 0.000636 |
| 461.4490 | 5.869 | 0.005003 | 461.3520 | 7.062 | 0.006098 | 461.5420 | 11.249 | 0.012431 |
| 462.4570 | 5.867 | -0.001547 | 462.3520 | 7.060 | 0.002284 | 462.5510 | 11.244 | 0.002875 |
| 463.4730 | 5.868 | 0.009707 | 463.3650 | 7.060 | -0.002101 | 463.5650 | 11.244 | 0.000080 |
| 464.4710 | 5.862 | -0.002448 | 464.3660 | 7.060 | 0.004515 | 464.5730 | 11.241 | 0.007747 |
| 465.4820 | 5.866 | 0.002222 | 465.3820 | 7.053 | -0.000436 | 465.5720 | 11.233 | 0.001956 |
| 466.4900 | 5.865 | 0.001818 | 466.3920 | 7.056 | -0.001275 | 466.5840 | 11.230 | 0.001571 |
| 467.4960 | 5.864 | -0.003887 | 467.3900 | 7.054 | 0.002676 | 467.5880 | 11.229 | 0.003854 |
| 468.4960 | 5.865 | -0.001895 | 468.3980 | 7.049 | 0.007889 | 468.6000 | 11.225 | 0.007029 |
| 469.5090 | 5.865 | 0.007125 | 469.4080 | 7.048 | -0.004768 | 469.6040 | 11.217 | 0.003996 |
| 470.5100 | 5.862 | -0.000011 | 470.4110 | 7.050 | 0.001379 | 470.6110 | 11.218 | 0.000376 |
| 471.5190 | 5.865 | -0.003587 | 471.4170 | 7.047 | 0.003413 | 471.6220 | 11.214 | 0.004828 |
| 472.5280 | 5.866 | -0.000066 | 472.4270 | 7.044 | -0.000487 | 472.6180 | 11.208 | 0.003767 |
| 473.5340 | 5.863 | 0.006092 | 473.4310 | 7.046 | 0.000594 | 473.6380 | 11.204 | 0.004788 |
| 474.5330 | 5.860 | -0.001023 | 474.4280 | 7.044 | 0.002847 | 474.6420 | 11.204 | -0.000492 |
| 475.5440 | 5.861 | 0.006797 | 475.4400 | 7.040 | 0.003559 | 475.6480 | 11.203 | 0.008599 |
| 476.5480 | 5.856 | 0.002620 | 476.4470 | 7.039 | -0.001370 | 476.6510 | 11.194 | 0.006443 |
| 477.5570 | 5.856 | -0.002771 | 477.4460 | 7.040 | 0.003716 | 477.6510 | 11.192 | -0.001789 |
| 478.5610 | 5.857 | 0.003549 | 478.4610 | 7.037 | 0.005464 | 478.6630 | 11.193 | 0.002447 |
| 479.5760 | 5.854 | 0.003975 | 479.4640 | 7.033 | -0.001703 | 479.6750 | 11.190 | 0.005989 |
| 480.5750 | 5.850 | -0.002053 | 480.4710 | 7.035 | -0.000880 | 480.6820 | 11.183 | 0.006666 |
| 481.5840 | 5.854 | -0.005064 | 481.4800 | 7.034 | 0.000977 | 481.6850 | 11.180 | 0.001384 |
| 482.5880 | 5.855 | 0.003888 | 482.4890 | 7.032 | 0.003970 | 482.6910 | 11.179 | 0.000655 |
| 483.5940 | 5.853 | 0.000641 | 483.4890 | 7.029 | -0.000460 | 483.7030 | 11.176 | 0.004855 |
| 484.6060 | 5.856 | -0.002512 | 484.4960 | 7.033 | 0.001732 | 484.7070 | 11.171 | -0.000324 |
| 485.6130 | 5.856 | 0.002323 | 485.5140 | 7.030 | 0.002369 | 485.7100 | 11.173 | 0.000078 |
| 486.6080 | 5.850 | 0.001711 | 486.5120 | 7.027 | 0.004399 | 486.7190 | 11.171 | 0.003996 |
| 487.6120 | 5.852 | 0.002311 | 487.5170 | 7.025 | -0.000405 | 487.7250 | 11.161 | 0.011403 |
| 488.6260 | 5.850 | -0.005643 | 488.5220 | 7.027 | -0.000821 | 488.7340 | 11.156 | -0.016787 |
| 489.6300 | 5.852 | -0.001349 | 489.5250 | 7.026 | 0.005314 | 489.7310 | 11.160 | -0.000501 |
| 490.6380 | 5.852 | 0.003721 | 490.5360 | 7.023 | 0.000008 | 490.7500 | 11.158 | 0.006867 |
| 491.6440 | 5.849 | 0.003768 | 491.5360 | 7.023 | -0.000969 | 491.7590 | 11.152 | 0.003996 |
| 492.6460 | 5.846 | -0.003447 | 492.5470 | 7.023 | -0.001832 | 492.7630 | 11.152 | -0.003371 |
| 493.6560 | 5.850 | 0.000479 | 493.5530 | 7.022 | 0.003581 | 493.7650 | 11.149 | 0.003806 |
| 494.6590 | 5.846 | -0.000410 | 494.5570 | 7.019 | -0.000787 | 494.7750 | 11.144 | 0.007416 |
| 495.6660 | 5.844 | 0.000750 | 495.5630 | 7.022 | -0.002620 | 495.7870 | 11.139 | 0.000498 |
| 496.6770 | 5.846 | 0.000060 | 496.5760 | 7.019 | 0.007131 | 496.7910 | 11.142 | -0.001961 |
| 497.6820 | 5.842 | 0.001568 | 497.5780 | 7.014 | 0.002655 | 497.7910 | 11.140 | 0.007195 |
| 498.6970 | 5.841 | 0.002301 | 498.5860 | 7.014 | -0.005589 | 498.8030 | 11.130 | 0.005990 |
| 499.6920 | 5.843 | 0.001247 | 499.5970 | 7.014 | 0.005505 | 499.8120 | 11.127 | -0.001483 |

Table C-3: Continued

| 1wt% MMT in Linear PMMA (10C/min) | | | 3wt% MMT in Lineard PMMA (10C/min) | | | 5wt% MMT in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 500.6980 | 5.840 | 0.003944 | 500.6040 | 7.007 | 0.000566 | 500.8150 | 11.129 | -0.000510 |
| 501.7090 | 5.840 | -0.000333 | 501.6090 | 7.007 | -0.002597 | 501.8260 | 11.127 | 0.006862 |
| 502.7210 | 5.838 | 0.006153 | 502.6200 | 7.010 | -0.000824 | 502.8350 | 11.119 | 0.001634 |
| 503.7260 | 5.833 | -0.000160 | 503.6190 | 7.009 | -0.000467 | 503.8320 | 11.121 | -0.006754 |
| 504.7340 | 5.833 | -0.001462 | 504.6280 | 7.006 | 0.004058 | 504.8420 | 11.123 | 0.005045 |
| 505.7400 | 5.833 | 0.004198 | 505.6280 | 7.005 | -0.005657 | 505.8510 | 11.115 | 0.009441 |

Table C-4: TGA and DTG for 1wt%, 3wt%, and 5wt% Silica in Cross-Linked PMMA

| 1wt% Silica in Cross-Linked PMMA (10C/min) | | | 3wt% Silica in Cross-Linked PMMA (10C/min) | | | 5wt% Silica in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 100.1160 | 100.000 | -0.012672 | 100.0310 | 100.000 | -0.001237 | 100.0470 | 100.000 | -0.001180 |
| 101.1040 | 100.006 | -0.000107 | 101.0110 | 100.000 | -0.006789 | 101.0220 | 100.004 | -0.001306 |
| 102.0820 | 100.008 | -0.008287 | 102.0010 | 100.003 | 0.004422 | 102.0040 | 100.003 | 0.004295 |
| 103.0650 | 100.011 | 0.000336 | 102.9920 | 100.006 | -0.001002 | 102.9850 | 100.005 | -0.000950 |
| 104.0410 | 100.013 | -0.010915 | 103.9690 | 100.008 | -0.001386 | 103.9750 | 100.004 | -0.001362 |
| 105.0220 | 100.020 | -0.001982 | 104.9560 | 100.010 | -0.001412 | 104.9610 | 100.007 | -0.001329 |
| 106.0210 | 100.020 | -0.005963 | 105.9390 | 100.012 | -0.001127 | 105.9450 | 100.006 | 0.004860 |
| 107.0040 | 100.028 | -0.007673 | 106.9250 | 100.010 | 0.004677 | 106.9360 | 100.007 | -0.000977 |
| 107.9940 | 100.027 | 0.001654 | 107.8990 | 100.012 | -0.007088 | 107.9160 | 100.004 | 0.004358 |
| 108.9800 | 100.032 | -0.004972 | 108.9010 | 100.013 | 0.004853 | 108.9000 | 100.000 | -0.001150 |
| 109.9710 | 100.033 | -0.003741 | 109.8980 | 100.012 | -0.001009 | 109.8910 | 100.003 | 0.004596 |
| 110.9670 | 100.037 | -0.006757 | 110.8750 | 100.016 | -0.001432 | 110.8830 | 100.001 | 0.004167 |
| 111.9620 | 100.042 | -0.001919 | 111.8740 | 100.014 | -0.001299 | 111.8770 | 99.998 | 0.004434 |
| 112.9450 | 100.040 | 0.000054 | 112.8690 | 100.012 | 0.004881 | 112.8630 | 99.993 | 0.004362 |
| 113.9360 | 100.043 | -0.001217 | 113.8530 | 100.008 | -0.001367 | 113.8630 | 99.990 | -0.001376 |
| 114.9310 | 100.040 | -0.001020 | 114.8560 | 100.013 | -0.007584 | 114.8560 | 99.984 | -0.001215 |
| 115.9340 | 100.046 | -0.009839 | 115.8610 | 100.011 | 0.005037 | 115.8540 | 99.984 | -0.001144 |
| 116.9250 | 100.049 | 0.002172 | 116.8470 | 100.009 | -0.001372 | 116.8450 | 99.982 | 0.004200 |
| 117.9250 | 100.046 | -0.002586 | 117.8410 | 100.010 | -0.006896 | 117.8620 | 99.976 | 0.004840 |
| 118.9300 | 100.045 | -0.000903 | 118.8460 | 100.008 | 0.010675 | 118.8460 | 99.972 | 0.004334 |
| 119.9200 | 100.046 | 0.000556 | 119.8480 | 100.003 | 0.004767 | 119.8410 | 99.967 | 0.010079 |
| 120.9230 | 100.043 | 0.004493 | 120.8520 | 99.999 | 0.004759 | 120.8520 | 99.962 | 0.004876 |
| 121.9190 | 100.038 | -0.000184 | 121.8500 | 100.000 | -0.001336 | 121.8400 | 99.958 | 0.004304 |
| 122.9240 | 100.039 | -0.000934 | 122.8480 | 99.996 | 0.004649 | 122.8410 | 99.950 | 0.010128 |
| 123.9250 | 100.035 | 0.009001 | 123.8460 | 99.989 | 0.004820 | 123.8680 | 99.941 | 0.004829 |
| 124.9320 | 100.026 | -0.008830 | 124.8550 | 99.988 | -0.000972 | 124.8660 | 99.935 | 0.010463 |
| 125.9360 | 100.032 | 0.002497 | 125.8580 | 99.990 | -0.001032 | 125.8690 | 99.928 | 0.004652 |
| 126.9370 | 100.025 | 0.005216 | 126.8640 | 99.986 | 0.004902 | 126.8730 | 99.923 | 0.016094 |
| 127.9440 | 100.022 | 0.003578 | 127.8720 | 99.977 | 0.004818 | 127.8890 | 99.914 | 0.010507 |
| 128.9580 | 100.020 | 0.001563 | 128.8810 | 99.976 | -0.000617 | 128.8910 | 99.906 | 0.016295 |
| 129.9620 | 100.016 | 0.007909 | 129.8910 | 99.972 | 0.005187 | 129.9000 | 99.896 | 0.004543 |
| 130.9730 | 100.005 | 0.002924 | 130.8990 | 99.967 | 0.017167 | 130.9140 | 99.890 | 0.004702 |
| 131.9730 | 100.006 | 0.000130 | 131.9070 | 99.960 | 0.004492 | 131.9330 | 99.881 | 0.010544 |
| 132.9860 | 100.004 | 0.002483 | 132.9340 | 99.954 | 0.011069 | 132.9470 | 99.873 | 0.004312 |
| 134.0050 | 100.002 | -0.000102 | 133.9370 | 99.946 | 0.010124 | 133.9660 | 99.864 | 0.009949 |
| 135.0240 | 100.001 | 0.002590 | 134.9490 | 99.941 | -0.001077 | 134.9820 | 99.852 | 0.004264 |
| 136.0320 | 99.996 | 0.006498 | 135.9730 | 99.937 | -0.000994 | 135.9970 | 99.847 | -0.000937 |
| 137.0500 | 99.988 | 0.010840 | 136.9910 | 99.937 | 0.004875 | 137.0220 | 99.840 | 0.011033 |
| 138.0660 | 99.979 | 0.000095 | 138.0000 | 99.929 | 0.010567 | 138.0390 | 99.835 | 0.004387 |
| 139.0890 | 99.984 | -0.003303 | 139.0340 | 99.922 | -0.001170 | 139.0570 | 99.826 | 0.004386 |
| 140.1040 | 99.981 | 0.013482 | 140.0530 | 99.918 | -0.000853 | 140.0800 | 99.820 | 0.010777 |
| 141.1200 | 99.972 | -0.000100 | 141.0700 | 99.918 | 0.010243 | 141.0870 | 99.810 | 0.004117 |
| 142.1400 | 99.977 | 0.006084 | 142.0840 | 99.909 | 0.004623 | 142.1130 | 99.804 | 0.004543 |
| 143.1410 | 99.966 | 0.005757 | 143.1170 | 99.908 | 0.004622 | 143.1340 | 99.799 | 0.004464 |
| 144.1620 | 99.966 | -0.000907 | 144.1320 | 99.900 | 0.010683 | 144.1550 | 99.792 | 0.004383 |
| 145.1790 | 99.964 | -0.002221 | 145.1490 | 99.893 | 0.004964 | 145.1780 | 99.786 | 0.010627 |
| 146.1920 | 99.967 | 0.002077 | 146.1660 | 99.895 | -0.000825 | 146.1910 | 99.781 | -0.000783 |
| 147.2090 | 99.962 | 0.005550 | 147.1800 | 99.892 | 0.004759 | 147.2150 | 99.778 | 0.009920 |
| 148.2320 | 99.960 | -0.001471 | 148.1970 | 99.889 | -0.000987 | 148.2260 | 99.772 | 0.009929 |
| 149.2550 | 99.957 | 0.003094 | 149.2140 | 99.890 | 0.004279 | 149.2450 | 99.762 | 0.004253 |
| 150.2680 | 99.955 | 0.001793 | 150.2340 | 99.886 | -0.001012 | 150.2620 | 99.756 | 0.004597 |
| 151.2810 | 99.951 | 0.005279 | 151.2600 | 99.880 | 0.004341 | 151.2740 | 99.750 | 0.004047 |
| 152.3010 | 99.946 | -0.004941 | 152.2670 | 99.877 | -0.000932 | 152.2930 | 99.746 | 0.004465 |
| 153.3130 | 99.949 | 0.001840 | 153.2900 | 99.880 | -0.000998 | 153.3090 | 99.742 | 0.004624 |
| 154.3340 | 99.943 | 0.007997 | 154.3080 | 99.873 | 0.004539 | 154.3250 | 99.737 | 0.004332 |
| 155.3590 | 99.944 | -0.002383 | 155.3350 | 99.871 | -0.001112 | 155.3460 | 99.732 | 0.004709 |
| 156.3810 | 99.939 | 0.013523 | 156.3400 | 99.872 | -0.006569 | 156.3630 | 99.726 | 0.010618 |
| 157.4050 | 99.940 | -0.006034 | 157.3580 | 99.872 | 0.004954 | 157.3760 | 99.721 | 0.004728 |
| 158.4170 | 99.939 | 0.014859 | 158.3810 | 99.868 | -0.001070 | 158.3860 | 99.716 | 0.010196 |
| 159.4410 | 99.932 | 0.001151 | 159.4010 | 99.867 | -0.000972 | 159.4070 | 99.706 | 0.004623 |
| 160.4550 | 99.936 | -0.003371 | 160.4170 | 99.867 | 0.004867 | 160.4340 | 99.702 | -0.000738 |
| 161.4820 | 99.934 | 0.004297 | 161.4300 | 99.861 | 0.004398 | 161.4470 | 99.698 | 0.004678 |
| 162.5040 | 99.931 | 0.004876 | 162.4590 | 99.859 | -0.001047 | 162.4680 | 99.693 | 0.004439 |
| 163.5240 | 99.927 | -0.000506 | 163.4750 | 99.859 | -0.000977 | 163.4810 | 99.685 | 0.009842 |
| 164.5400 | 99.929 | -0.000063 | 164.4920 | 99.857 | -0.001137 | 164.5120 | 99.678 | -0.007143 |
| 165.5630 | 99.922 | 0.012072 | 165.5200 | 99.859 | -0.000792 | 165.5250 | 99.675 | 0.004897 |

Table C-4: Continued

| 1wt% Silica in Cross-Linked PMMA (10C/min) | | | 3wt% Silica in Cross-Linked PMMA (10C/min) | | | 5wt% Silica in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 166.5720 | 99.921 | -0.006256 | 166.5370 | 99.857 | -0.000787 | 166.5440 | 99.666 | 0.004841 |
| 167.6080 | 99.925 | 0.005046 | 167.5710 | 99.854 | 0.005082 | 167.5660 | 99.661 | 0.004649 |
| 168.6310 | 99.922 | -0.002593 | 168.5860 | 99.850 | -0.006789 | 168.5860 | 99.656 | 0.004488 |
| 169.6440 | 99.922 | 0.005491 | 169.6030 | 99.849 | 0.004597 | 169.6110 | 99.650 | -0.000999 |
| 170.6760 | 99.919 | -0.004035 | 170.6300 | 99.845 | 0.004489 | 170.6260 | 99.643 | 0.010149 |
| 171.7030 | 99.919 | 0.010690 | 171.6550 | 99.842 | -0.000966 | 171.6540 | 99.636 | -0.000956 |
| 172.7160 | 99.911 | -0.005948 | 172.6700 | 99.843 | -0.000922 | 172.6680 | 99.632 | 0.010098 |
| 173.7490 | 99.922 | 0.007205 | 173.7010 | 99.842 | -0.001076 | 173.6870 | 99.625 | 0.004340 |
| 174.7710 | 99.914 | 0.004229 | 174.7210 | 99.843 | 0.005018 | 174.7150 | 99.619 | 0.004815 |
| 175.8030 | 99.912 | 0.001151 | 175.7440 | 99.836 | 0.004993 | 175.7400 | 99.611 | 0.004850 |
| 176.8210 | 99.916 | -0.001481 | 176.7590 | 99.837 | -0.000975 | 176.7600 | 99.606 | 0.004624 |
| 177.8480 | 99.913 | 0.006997 | 177.7830 | 99.836 | 0.004894 | 177.7840 | 99.596 | 0.004726 |
| 178.8640 | 99.907 | -0.000893 | 178.8060 | 99.831 | 0.004538 | 178.8000 | 99.594 | -0.001210 |
| 179.8870 | 99.909 | -0.000834 | 179.8310 | 99.824 | 0.009977 | 179.8290 | 99.590 | 0.009918 |
| 180.9210 | 99.909 | 0.004265 | 180.8520 | 99.823 | -0.001097 | 180.8550 | 99.583 | 0.004516 |
| 181.9460 | 99.908 | -0.005580 | 181.8810 | 99.820 | 0.010643 | 181.8770 | 99.578 | 0.016360 |
| 182.9660 | 99.906 | 0.006255 | 182.9010 | 99.813 | 0.004900 | 182.9010 | 99.570 | 0.010270 |
| 183.9940 | 99.900 | 0.005528 | 183.9240 | 99.813 | -0.001108 | 183.9310 | 99.564 | 0.004438 |
| 185.0190 | 99.900 | -0.001120 | 184.9480 | 99.814 | 0.005103 | 184.9500 | 99.558 | 0.004782 |
| 186.0370 | 99.898 | 0.007488 | 185.9730 | 99.809 | 0.004903 | 185.9700 | 99.555 | 0.004734 |
| 187.0680 | 99.898 | -0.003910 | 186.9860 | 99.801 | 0.004597 | 186.9920 | 99.550 | 0.004570 |
| 188.0890 | 99.900 | 0.007459 | 188.0180 | 99.799 | -0.001020 | 188.0250 | 99.545 | 0.004597 |
| 189.1200 | 99.894 | 0.006767 | 189.0420 | 99.798 | 0.004732 | 189.0440 | 99.538 | 0.010759 |
| 190.1370 | 99.891 | 0.002409 | 190.0660 | 99.798 | 0.004677 | 190.0710 | 99.532 | -0.006616 |
| 191.1730 | 99.889 | 0.001873 | 191.0880 | 99.791 | 0.004520 | 191.0890 | 99.531 | 0.009817 |
| 192.1970 | 99.886 | 0.005598 | 192.1140 | 99.787 | 0.004813 | 192.1250 | 99.522 | 0.004729 |
| 193.2120 | 99.880 | 0.006265 | 193.1360 | 99.783 | 0.004382 | 193.1490 | 99.517 | -0.001247 |
| 194.2330 | 99.875 | -0.000476 | 194.1580 | 99.778 | 0.004625 | 194.1620 | 99.513 | 0.004569 |
| 195.2620 | 99.872 | 0.005164 | 195.1850 | 99.771 | 0.004677 | 195.1910 | 99.506 | 0.004543 |
| 196.2850 | 99.873 | -0.005756 | 196.2110 | 99.768 | 0.004982 | 196.2110 | 99.503 | -0.000743 |
| 197.3130 | 99.870 | 0.014308 | 197.2350 | 99.764 | 0.004434 | 197.2440 | 99.497 | 0.004307 |
| 198.3400 | 99.861 | -0.002328 | 198.2620 | 99.759 | 0.004761 | 198.2670 | 99.493 | 0.004597 |
| 199.3670 | 99.865 | 0.007537 | 199.2850 | 99.757 | 0.004705 | 199.2940 | 99.488 | 0.004678 |
| 200.3930 | 99.852 | 0.005796 | 200.3200 | 99.754 | -0.001120 | 200.3210 | 99.481 | 0.004338 |
| 201.4170 | 99.853 | -0.003303 | 201.3380 | 99.745 | 0.004332 | 201.3400 | 99.476 | -0.001182 |
| 202.4510 | 99.845 | 0.004387 | 202.3590 | 99.741 | 0.004467 | 202.3690 | 99.474 | 0.004267 |
| 203.4780 | 99.847 | -0.007236 | 203.3890 | 99.735 | 0.004465 | 203.3990 | 99.467 | 0.009997 |
| 204.4940 | 99.843 | 0.010443 | 204.4270 | 99.731 | 0.004567 | 204.4290 | 99.460 | 0.004310 |
| 205.5240 | 99.838 | -0.007678 | 205.4550 | 99.729 | 0.004489 | 205.4540 | 99.457 | 0.004411 |
| 206.5660 | 99.835 | 0.015753 | 206.4790 | 99.721 | 0.004759 | 206.4880 | 99.453 | 0.004492 |
| 207.5830 | 99.823 | -0.006614 | 207.5190 | 99.718 | 0.004870 | 207.5190 | 99.448 | 0.004648 |
| 208.6190 | 99.820 | 0.006530 | 208.5440 | 99.714 | -0.001183 | 208.5470 | 99.441 | 0.004331 |
| 209.6450 | 99.813 | 0.002685 | 209.5740 | 99.711 | 0.010903 | 209.5630 | 99.434 | 0.009491 |
| 210.6770 | 99.814 | 0.006573 | 210.6040 | 99.701 | 0.004732 | 210.6040 | 99.427 | 0.004596 |
| 211.7110 | 99.800 | 0.009599 | 211.6370 | 99.693 | 0.004435 | 211.6360 | 99.423 | 0.009976 |
| 212.7420 | 99.802 | -0.002220 | 212.6650 | 99.688 | 0.004791 | 212.6610 | 99.415 | 0.004653 |
| 213.7610 | 99.793 | 0.021656 | 213.6970 | 99.684 | 0.004677 | 213.6960 | 99.409 | 0.009847 |
| 214.7980 | 99.783 | -0.000463 | 214.7300 | 99.679 | 0.004961 | 214.7250 | 99.403 | -0.000869 |
| 215.8360 | 99.784 | 0.015467 | 215.7530 | 99.672 | 0.016072 | 215.7460 | 99.400 | 0.010018 |
| 216.8550 | 99.771 | 0.011859 | 216.7830 | 99.663 | 0.004867 | 216.7880 | 99.390 | 0.010563 |
| 217.8920 | 99.764 | 0.010663 | 217.8100 | 99.660 | 0.004758 | 217.8210 | 99.382 | 0.004757 |
| 218.9130 | 99.754 | 0.009382 | 218.8440 | 99.654 | 0.004704 | 218.8480 | 99.374 | 0.004622 |
| 219.9500 | 99.745 | 0.007368 | 219.8750 | 99.647 | 0.010164 | 219.8860 | 99.367 | -0.000981 |
| 220.9730 | 99.732 | 0.005723 | 220.9060 | 99.636 | 0.004894 | 220.9060 | 99.365 | 0.010106 |
| 222.0200 | 99.732 | 0.002746 | 221.9260 | 99.631 | 0.004523 | 221.9380 | 99.357 | 0.010092 |
| 223.0430 | 99.719 | 0.017232 | 222.9700 | 99.624 | -0.000900 | 222.9750 | 99.349 | 0.010749 |
| 224.0710 | 99.711 | 0.001053 | 224.0010 | 99.621 | 0.010396 | 223.9970 | 99.341 | 0.004517 |
| 225.0910 | 99.703 | 0.013556 | 225.0280 | 99.614 | 0.010387 | 225.0350 | 99.334 | 0.004571 |
| 226.1330 | 99.691 | 0.009361 | 226.0550 | 99.603 | 0.004677 | 226.0550 | 99.323 | 0.009982 |
| 227.1680 | 99.681 | 0.015807 | 227.0950 | 99.597 | 0.010608 | 227.0910 | 99.314 | 0.004677 |
| 228.1860 | 99.665 | 0.010769 | 228.1220 | 99.587 | 0.004410 | 228.1170 | 99.310 | 0.010155 |
| 229.2170 | 99.659 | 0.005733 | 229.1490 | 99.580 | 0.004570 | 229.1420 | 99.298 | 0.009710 |
| 230.2460 | 99.643 | 0.017501 | 230.1840 | 99.574 | 0.010124 | 230.1810 | 99.290 | 0.010118 |
| 231.2770 | 99.629 | 0.006179 | 231.2110 | 99.564 | 0.010828 | 231.2080 | 99.280 | 0.016025 |
| 232.3100 | 99.622 | 0.009927 | 232.2340 | 99.555 | 0.010525 | 232.2410 | 99.269 | 0.004837 |
| 233.3440 | 99.609 | 0.018058 | 233.2760 | 99.550 | 0.010586 | 233.2610 | 99.264 | 0.015338 |

Table C-4: Continued

| 1wt% Silica in Cross-Linked PMMA (10C/min) | | | 3wt% Silica in Cross-Linked PMMA (10C/min) | | | 5wt% Silica in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 234.3580 | 99.594 | 0.016312 | 234.2970 | 99.542 | 0.004541 | 234.3050 | 99.250 | 0.010628 |
| 235.4000 | 99.581 | 0.003716 | 235.3340 | 99.533 | 0.010438 | 235.3250 | 99.243 | 0.015758 |
| 236.4190 | 99.568 | 0.018562 | 236.3630 | 99.521 | 0.016770 | 236.3610 | 99.229 | 0.015535 |
| 237.4580 | 99.550 | 0.003390 | 237.3970 | 99.511 | 0.004677 | 237.3840 | 99.217 | 0.009735 |
| 238.4870 | 99.543 | 0.008560 | 238.4250 | 99.504 | 0.010223 | 238.4180 | 99.204 | 0.015637 |
| 239.5190 | 99.528 | 0.021165 | 239.4590 | 99.497 | 0.004868 | 239.4480 | 99.191 | 0.010599 |
| 240.5490 | 99.514 | 0.009644 | 240.4900 | 99.485 | 0.010282 | 240.4780 | 99.183 | 0.015822 |
| 241.5640 | 99.506 | 0.006391 | 241.5200 | 99.474 | 0.010608 | 241.5080 | 99.165 | 0.010365 |
| 242.6040 | 99.493 | 0.015070 | 242.5430 | 99.461 | 0.010239 | 242.5340 | 99.153 | 0.015410 |
| 243.6290 | 99.477 | 0.017094 | 243.5660 | 99.453 | 0.009771 | 243.5620 | 99.137 | 0.021224 |
| 244.6530 | 99.461 | 0.012483 | 244.6010 | 99.443 | 0.010719 | 244.5930 | 99.120 | 0.015823 |
| 245.6890 | 99.450 | 0.015328 | 245.6300 | 99.430 | 0.010411 | 245.6240 | 99.104 | 0.010473 |
| 246.7220 | 99.434 | 0.012972 | 246.6630 | 99.415 | 0.010331 | 246.6550 | 99.096 | 0.009803 |
| 247.7460 | 99.424 | 0.010660 | 247.6850 | 99.405 | 0.010595 | 247.6770 | 99.082 | 0.020402 |
| 248.7830 | 99.405 | 0.021671 | 248.7170 | 99.396 | 0.004842 | 248.7110 | 99.065 | 0.015498 |
| 249.8060 | 99.391 | 0.014601 | 249.7430 | 99.383 | 0.009920 | 249.7350 | 99.052 | 0.009636 |
| 250.8310 | 99.376 | 0.019571 | 250.7760 | 99.373 | 0.005026 | 250.7580 | 99.035 | 0.020596 |
| 251.8650 | 99.357 | 0.013090 | 251.8030 | 99.359 | 0.010532 | 251.7920 | 99.019 | 0.009877 |
| 252.8840 | 99.346 | 0.015289 | 252.8330 | 99.345 | 0.015705 | 252.8190 | 99.005 | 0.015703 |
| 253.9120 | 99.326 | 0.015493 | 253.8610 | 99.333 | 0.010772 | 253.8490 | 98.989 | 0.015509 |
| 254.9400 | 99.311 | 0.011899 | 254.8900 | 99.320 | 0.015795 | 254.8750 | 98.971 | 0.020313 |
| 255.9730 | 99.294 | 0.021284 | 255.9170 | 99.307 | 0.015751 | 255.9060 | 98.952 | 0.015299 |
| 256.9940 | 99.274 | 0.011945 | 256.9490 | 99.292 | 0.010393 | 256.9320 | 98.936 | 0.009803 |
| 258.0210 | 99.260 | 0.015744 | 257.9710 | 99.284 | 0.010457 | 257.9550 | 98.919 | 0.015691 |
| 259.0560 | 99.245 | 0.014778 | 259.0070 | 99.272 | 0.010772 | 258.9890 | 98.897 | 0.021996 |
| 260.0760 | 99.227 | 0.017412 | 260.0320 | 99.260 | 0.015822 | 260.0090 | 98.877 | 0.021048 |
| 261.1050 | 99.209 | 0.010666 | 261.0510 | 99.240 | 0.016181 | 261.0330 | 98.857 | 0.015271 |
| 262.1390 | 99.195 | 0.018215 | 262.0800 | 99.225 | 0.014715 | 262.0650 | 98.838 | 0.015036 |
| 263.1640 | 99.171 | 0.018503 | 263.1070 | 99.213 | 0.010320 | 263.0890 | 98.814 | 0.026317 |
| 264.1940 | 99.157 | 0.014334 | 264.1310 | 99.200 | 0.016781 | 264.1190 | 98.793 | 0.021357 |
| 265.2180 | 99.137 | 0.022184 | 265.1560 | 99.183 | 0.015429 | 265.1380 | 98.772 | 0.020022 |
| 266.2460 | 99.116 | 0.016407 | 266.1830 | 99.170 | 0.015913 | 266.1750 | 98.750 | 0.027845 |
| 267.2680 | 99.100 | 0.025472 | 267.2120 | 99.151 | 0.021779 | 267.2060 | 98.725 | 0.022051 |
| 268.3020 | 99.078 | 0.020337 | 268.2370 | 99.134 | 0.016006 | 268.2240 | 98.702 | 0.027021 |
| 269.3200 | 99.056 | 0.028742 | 269.2630 | 99.120 | 0.021340 | 269.2460 | 98.679 | 0.025723 |
| 270.3390 | 99.032 | 0.016743 | 270.2940 | 99.101 | 0.016181 | 270.2770 | 98.651 | 0.021127 |
| 271.3740 | 99.016 | 0.020105 | 271.3240 | 99.084 | 0.021760 | 271.2980 | 98.630 | 0.020531 |
| 272.4000 | 98.992 | 0.026093 | 272.3480 | 99.064 | 0.016249 | 272.3360 | 98.604 | 0.033065 |
| 273.4250 | 98.969 | 0.019687 | 273.3680 | 99.050 | 0.016484 | 273.3630 | 98.576 | 0.020989 |
| 274.4500 | 98.948 | 0.024529 | 274.3940 | 99.033 | 0.022145 | 274.3750 | 98.550 | 0.032076 |
| 275.4760 | 98.922 | 0.029748 | 275.4260 | 99.013 | 0.021490 | 275.4040 | 98.519 | 0.020995 |
| 276.5000 | 98.892 | 0.026822 | 276.4480 | 98.992 | 0.015908 | 276.4280 | 98.493 | 0.025766 |
| 277.5250 | 98.867 | 0.023179 | 277.4760 | 98.972 | 0.022641 | 277.4520 | 98.464 | 0.026782 |
| 278.5530 | 98.846 | 0.023504 | 278.4950 | 98.952 | 0.015171 | 278.4760 | 98.434 | 0.027456 |
| 279.5740 | 98.819 | 0.026687 | 279.5210 | 98.934 | 0.015924 | 279.5050 | 98.405 | 0.027101 |
| 280.6020 | 98.794 | 0.024795 | 280.5520 | 98.915 | 0.021980 | 280.5290 | 98.375 | 0.032292 |
| 281.6290 | 98.769 | 0.028896 | 281.5670 | 98.891 | 0.027494 | 281.5500 | 98.340 | 0.030798 |
| 282.6460 | 98.742 | 0.027815 | 282.6010 | 98.870 | 0.015951 | 282.5820 | 98.310 | 0.032186 |
| 283.6670 | 98.710 | 0.027756 | 283.6170 | 98.852 | 0.021098 | 283.6020 | 98.279 | 0.030665 |
| 284.6960 | 98.683 | 0.023076 | 284.6370 | 98.831 | 0.015768 | 284.6260 | 98.246 | 0.032375 |
| 285.7200 | 98.658 | 0.027577 | 285.6650 | 98.810 | 0.022431 | 285.6510 | 98.211 | 0.031606 |
| 286.7460 | 98.628 | 0.031512 | 286.6860 | 98.788 | 0.015849 | 286.6810 | 98.179 | 0.038021 |
| 287.7730 | 98.600 | 0.029387 | 287.7170 | 98.768 | 0.021310 | 287.7020 | 98.140 | 0.037905 |
| 288.8020 | 98.569 | 0.038795 | 288.7310 | 98.750 | 0.021272 | 288.7280 | 98.104 | 0.032984 |
| 289.8270 | 98.534 | 0.030193 | 289.7660 | 98.726 | 0.021626 | 289.7430 | 98.066 | 0.036569 |
| 290.8440 | 98.505 | 0.037516 | 290.7890 | 98.705 | 0.023647 | 290.7720 | 98.029 | 0.032425 |
| 291.8620 | 98.473 | 0.028116 | 291.8060 | 98.681 | 0.021697 | 291.7970 | 97.990 | 0.042102 |
| 292.8860 | 98.443 | 0.040718 | 292.8330 | 98.657 | 0.027600 | 292.8180 | 97.949 | 0.036857 |
| 293.9160 | 98.406 | 0.029063 | 293.8560 | 98.631 | 0.021697 | 293.8370 | 97.913 | 0.036518 |
| 294.9370 | 98.383 | 0.026476 | 294.8790 | 98.611 | 0.022193 | 294.8650 | 97.873 | 0.043953 |
| 295.9590 | 98.347 | 0.037861 | 295.9010 | 98.591 | 0.027302 | 295.8990 | 97.831 | 0.038258 |
| 296.9780 | 98.317 | 0.031834 | 296.9340 | 98.564 | 0.030167 | 296.9110 | 97.790 | 0.043333 |
| 298.0100 | 98.285 | 0.031384 | 297.9460 | 98.536 | 0.027545 | 297.9370 | 97.747 | 0.043971 |
| 299.0260 | 98.252 | 0.033058 | 298.9660 | 98.506 | 0.027176 | 298.9660 | 97.705 | 0.050010 |
| 300.0460 | 98.213 | 0.040510 | 299.9910 | 98.478 | 0.021787 | 299.9860 | 97.659 | 0.043684 |

Table C-4: Continued

| 1wt% Silica in Cross-Linked PMMA (10C/min) | | | 3wt% Silica in Cross-Linked PMMA (10C/min) | | | 5wt% Silica in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 301.0710 | 98.175 | 0.029078 | 301.0100 | 98.455 | 0.026334 | 301.0120 | 97.615 | 0.043999 |
| 302.0950 | 98.142 | 0.038826 | 302.0370 | 98.425 | 0.027384 | 302.0260 | 97.569 | 0.041736 |
| 303.1130 | 98.099 | 0.039241 | 303.0660 | 98.396 | 0.032646 | 303.0460 | 97.525 | 0.040939 |
| 304.1420 | 98.060 | 0.039788 | 304.0820 | 98.362 | 0.037839 | 304.0720 | 97.477 | 0.047298 |
| 305.1630 | 98.015 | 0.044289 | 305.1060 | 98.324 | 0.027171 | 305.1020 | 97.426 | 0.048967 |
| 306.1710 | 97.973 | 0.036992 | 306.1290 | 98.289 | 0.032299 | 306.1200 | 97.375 | 0.048144 |
| 307.1970 | 97.927 | 0.050756 | 307.1540 | 98.253 | 0.033335 | 307.1360 | 97.320 | 0.052006 |
| 308.2290 | 97.876 | 0.042674 | 308.1750 | 98.219 | 0.033895 | 308.1650 | 97.267 | 0.050119 |
| 309.2430 | 97.827 | 0.060733 | 309.1940 | 98.179 | 0.039750 | 309.1800 | 97.211 | 0.052984 |
| 310.2630 | 97.765 | 0.051894 | 310.2200 | 98.137 | 0.047178 | 310.2100 | 97.151 | 0.054801 |
| 311.2830 | 97.713 | 0.057661 | 311.2410 | 98.086 | 0.044958 | 311.2190 | 97.090 | 0.063686 |
| 312.3000 | 97.649 | 0.058532 | 312.2540 | 98.040 | 0.050413 | 312.2510 | 97.022 | 0.064664 |
| 313.3270 | 97.589 | 0.060709 | 313.2830 | 97.993 | 0.043763 | 313.2730 | 96.955 | 0.068179 |
| 314.3470 | 97.519 | 0.067237 | 314.2950 | 97.942 | 0.050146 | 314.2920 | 96.880 | 0.073418 |
| 315.3670 | 97.456 | 0.065147 | 315.3140 | 97.892 | 0.049566 | 315.3070 | 96.806 | 0.070431 |
| 316.3870 | 97.381 | 0.094396 | 316.3350 | 97.836 | 0.060856 | 316.3340 | 96.728 | 0.082906 |
| 317.4030 | 97.300 | 0.071939 | 317.3630 | 97.771 | 0.062874 | 317.3460 | 96.646 | 0.080367 |
| 318.4210 | 97.227 | 0.087368 | 318.3730 | 97.712 | 0.062186 | 318.3700 | 96.558 | 0.093997 |
| 319.4370 | 97.137 | 0.082606 | 319.3990 | 97.648 | 0.069601 | 319.3940 | 96.466 | 0.088279 |
| 320.4570 | 97.051 | 0.084855 | 320.4130 | 97.580 | 0.060911 | 320.4060 | 96.374 | 0.091113 |
| 321.4720 | 96.960 | 0.090024 | 321.4320 | 97.510 | 0.067688 | 321.4260 | 96.272 | 0.100325 |
| 322.5010 | 96.863 | 0.104688 | 322.4520 | 97.436 | 0.078311 | 322.4520 | 96.171 | 0.107316 |
| 323.5240 | 96.759 | 0.100011 | 323.4710 | 97.354 | 0.081113 | 323.4620 | 96.058 | 0.112585 |
| 324.5340 | 96.655 | 0.111245 | 324.4930 | 97.267 | 0.097641 | 324.4860 | 95.943 | 0.120958 |
| 325.5590 | 96.535 | 0.117726 | 325.5080 | 97.182 | 0.088957 | 325.5000 | 95.821 | 0.126869 |
| 326.5720 | 96.415 | 0.113965 | 326.5150 | 97.091 | 0.100913 | 326.5210 | 95.687 | 0.135763 |
| 327.5900 | 96.291 | 0.122215 | 327.5440 | 96.992 | 0.107316 | 327.5350 | 95.552 | 0.132729 |
| 328.6110 | 96.156 | 0.132781 | 328.5580 | 96.885 | 0.102217 | 328.5620 | 95.407 | 0.152701 |
| 329.6290 | 96.015 | 0.145512 | 329.5650 | 96.777 | 0.107643 | 329.5780 | 95.254 | 0.153716 |
| 330.6480 | 95.860 | 0.152193 | 330.5930 | 96.659 | 0.112816 | 330.5880 | 95.091 | 0.163010 |
| 331.6640 | 95.700 | 0.166889 | 331.6110 | 96.538 | 0.125791 | 331.6070 | 94.918 | 0.164775 |
| 332.6880 | 95.529 | 0.175263 | 332.6180 | 96.404 | 0.135769 | 332.6290 | 94.737 | 0.195202 |
| 333.6980 | 95.346 | 0.189483 | 333.6400 | 96.265 | 0.139405 | 333.6380 | 94.543 | 0.195917 |
| 334.7150 | 95.153 | 0.195518 | 334.6510 | 96.120 | 0.143800 | 334.6600 | 94.340 | 0.203028 |
| 335.7310 | 94.952 | 0.197399 | 335.6720 | 95.962 | 0.162799 | 335.6670 | 94.122 | 0.225557 |
| 336.7490 | 94.731 | 0.225649 | 336.6840 | 95.796 | 0.163654 | 336.6840 | 93.890 | 0.231296 |
| 337.7610 | 94.495 | 0.241042 | 337.6990 | 95.617 | 0.176433 | 337.6980 | 93.641 | 0.255002 |
| 338.7780 | 94.249 | 0.263454 | 338.7150 | 95.425 | 0.196030 | 338.7180 | 93.382 | 0.266355 |
| 339.7920 | 93.983 | 0.278855 | 339.7280 | 95.220 | 0.202499 | 339.7250 | 93.103 | 0.283526 |
| 340.8090 | 93.698 | 0.288105 | 340.7420 | 95.007 | 0.207290 | 340.7460 | 92.806 | 0.315242 |
| 341.8210 | 93.403 | 0.317593 | 341.7580 | 94.779 | 0.241108 | 341.7530 | 92.495 | 0.317184 |
| 342.8320 | 93.078 | 0.319773 | 342.7730 | 94.531 | 0.259662 | 342.7660 | 92.160 | 0.341400 |
| 343.8470 | 92.735 | 0.352681 | 343.7860 | 94.266 | 0.272103 | 343.7750 | 91.803 | 0.364217 |
| 344.8690 | 92.375 | 0.385699 | 344.7990 | 93.986 | 0.290631 | 344.7840 | 91.424 | 0.384825 |
| 345.8730 | 91.987 | 0.425220 | 345.8080 | 93.687 | 0.303942 | 345.7990 | 91.022 | 0.429260 |
| 346.8850 | 91.569 | 0.419705 | 346.8240 | 93.368 | 0.346559 | 346.8070 | 90.596 | 0.432595 |
| 347.8900 | 91.133 | 0.437497 | 347.8290 | 93.025 | 0.351106 | 347.8180 | 90.145 | 0.472030 |
| 348.9000 | 90.663 | 0.465826 | 348.8430 | 92.663 | 0.368413 | 348.8180 | 89.668 | 0.474958 |
| 349.9120 | 90.166 | 0.510807 | 349.8510 | 92.279 | 0.395355 | 349.8300 | 89.164 | 0.531567 |
| 350.9170 | 89.631 | 0.521546 | 350.8580 | 91.859 | 0.423651 | 350.8380 | 88.625 | 0.533248 |
| 351.9330 | 89.065 | 0.559983 | 351.8620 | 91.409 | 0.488017 | 351.8570 | 88.060 | 0.606741 |
| 352.9450 | 88.468 | 0.626764 | 352.8790 | 90.915 | 0.501071 | 352.8620 | 87.457 | 0.624664 |
| 353.9450 | 87.824 | 0.616021 | 353.8870 | 90.392 | 0.529800 | 353.8700 | 86.824 | 0.676197 |
| 354.9570 | 87.150 | 0.679711 | 354.8920 | 89.843 | 0.558662 | 354.8730 | 86.147 | 0.678043 |
| 355.9710 | 86.430 | 0.730648 | 355.9010 | 89.259 | 0.606343 | 355.8740 | 85.442 | 0.731115 |
| 356.9730 | 85.668 | 0.768918 | 356.9060 | 88.626 | 0.686753 | 356.8800 | 84.691 | 0.788547 |
| 357.9810 | 84.857 | 0.815494 | 357.9080 | 87.926 | 0.711449 | 357.8850 | 83.882 | 0.840232 |
| 359.0000 | 84.010 | 0.910582 | 358.9120 | 87.174 | 0.738278 | 358.8930 | 83.020 | 0.876524 |
| 360.0010 | 83.110 | 0.944991 | 359.9240 | 86.336 | 0.985675 | 359.8920 | 82.122 | 0.901897 |
| 361.0070 | 82.163 | 0.994366 | 360.9240 | 85.278 | 1.069926 | 360.8990 | 81.188 | 0.939620 |
| 362.0040 | 81.176 | 1.014583 | 361.9180 | 84.185 | 1.067050 | 361.9050 | 80.190 | 1.039741 |
| 363.0080 | 80.108 | 1.094080 | 362.9170 | 83.102 | 1.091931 | 362.9020 | 79.127 | 1.091622 |
| 364.0130 | 78.991 | 1.120507 | 363.9170 | 81.972 | 1.114650 | 363.8990 | 78.023 | 1.088964 |
| 365.0150 | 77.832 | 1.143248 | 364.9230 | 80.789 | 1.173509 | 364.9070 | 76.863 | 1.188408 |
| 366.0280 | 76.635 | 1.291308 | 365.9250 | 79.544 | 1.265753 | 365.9090 | 75.647 | 1.199575 |

Table C-4: Continued

| 1wt% Silica in Cross-Linked PMMA (10C/min) | | | 3wt% Silica in Cross-Linked PMMA (10C/min) | | | 5wt% Silica in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 367.0270 | 75.312 | 1.360571 | 366.9310 | 78.272 | 1.339423 | 366.9100 | 74.409 | 1.246702 |
| 368.0290 | 73.958 | 1.353074 | 367.9190 | 76.990 | 1.289927 | 367.9130 | 73.160 | 1.299766 |
| 369.0350 | 72.587 | 1.367066 | 368.9270 | 75.665 | 1.375459 | 368.9150 | 71.869 | 1.304069 |
| 370.0410 | 71.137 | 1.489786 | 369.9240 | 74.250 | 1.446931 | 369.9180 | 70.509 | 1.409804 |
| 371.0460 | 69.576 | 1.567236 | 370.9300 | 72.789 | 1.507039 | 370.9170 | 69.125 | 1.378008 |
| 372.0450 | 68.020 | 1.500823 | 371.9260 | 71.291 | 1.464725 | 371.9120 | 67.732 | 1.401938 |
| 373.0530 | 66.478 | 1.509352 | 372.9230 | 69.781 | 1.455403 | 372.9250 | 66.295 | 1.531831 |
| 374.0600 | 64.904 | 1.532923 | 373.9310 | 68.248 | 1.626704 | 373.9250 | 64.802 | 1.565208 |
| 375.0650 | 63.309 | 1.622752 | 374.9260 | 66.622 | 1.678955 | 374.9220 | 63.319 | 1.462627 |
| 376.0670 | 61.678 | 1.557073 | 375.9340 | 64.943 | 1.721582 | 375.9270 | 61.827 | 1.484023 |
| 377.0810 | 60.038 | 1.652865 | 376.9430 | 63.300 | 1.634803 | 376.9390 | 60.307 | 1.525960 |
| 378.0890 | 58.379 | 1.685777 | 377.9430 | 61.675 | 1.586096 | 377.9420 | 58.796 | 1.478959 |
| 379.0900 | 56.735 | 1.549841 | 378.9480 | 60.045 | 1.578406 | 378.9530 | 57.282 | 1.495713 |
| 380.1010 | 55.121 | 1.634766 | 379.9560 | 58.400 | 1.627656 | 379.9580 | 55.747 | 1.453939 |
| 381.1080 | 53.511 | 1.589620 | 380.9630 | 56.732 | 1.593571 | 380.9770 | 54.210 | 1.561164 |
| 382.1210 | 51.904 | 1.540204 | 381.9760 | 55.084 | 1.591848 | 381.9800 | 52.658 | 1.545624 |
| 383.1290 | 50.328 | 1.565040 | 382.9860 | 53.460 | 1.549902 | 382.9890 | 51.096 | 1.517487 |
| 384.1390 | 48.778 | 1.500127 | 384.0020 | 51.852 | 1.497035 | 384.0070 | 49.542 | 1.540795 |
| 385.1600 | 47.260 | 1.429278 | 385.0190 | 50.260 | 1.582253 | 385.0240 | 48.001 | 1.561368 |
| 386.1740 | 45.769 | 1.510383 | 386.0400 | 48.687 | 1.549555 | 386.0380 | 46.477 | 1.547781 |
| 387.1830 | 44.323 | 1.329791 | 387.0510 | 47.137 | 1.483961 | 387.0470 | 44.967 | 1.471273 |
| 388.2110 | 42.919 | 1.381146 | 388.0710 | 45.611 | 1.495100 | 388.0700 | 43.475 | 1.453130 |
| 389.2290 | 41.556 | 1.373284 | 389.0840 | 44.117 | 1.507547 | 389.0890 | 42.015 | 1.409941 |
| 390.2420 | 40.235 | 1.212954 | 390.1130 | 42.653 | 1.456688 | 390.1130 | 40.565 | 1.398573 |
| 391.2600 | 38.966 | 1.223791 | 391.1320 | 41.221 | 1.449401 | 391.1340 | 39.143 | 1.395061 |
| 392.2810 | 37.738 | 1.147875 | 392.1430 | 39.831 | 1.347956 | 392.1570 | 37.772 | 1.301983 |
| 393.3100 | 36.549 | 1.127492 | 393.1670 | 38.471 | 1.285706 | 393.1800 | 36.439 | 1.307963 |
| 394.3330 | 35.413 | 1.106640 | 394.1880 | 37.156 | 1.288233 | 394.2140 | 35.150 | 1.330894 |
| 395.3510 | 34.315 | 1.050041 | 395.2020 | 35.880 | 1.175158 | 395.2250 | 33.901 | 1.146226 |
| 396.3710 | 33.260 | 0.991224 | 396.2330 | 34.646 | 1.170802 | 396.2510 | 32.702 | 1.150511 |
| 397.3990 | 32.242 | 1.020342 | 397.2510 | 33.450 | 1.144779 | 397.2840 | 31.539 | 1.125093 |
| 398.4190 | 31.261 | 0.916219 | 398.2730 | 32.299 | 1.067920 | 398.3060 | 30.424 | 1.055521 |
| 399.4410 | 30.325 | 0.906200 | 399.3000 | 31.193 | 1.051435 | 399.3260 | 29.347 | 1.044996 |
| 400.4640 | 29.432 | 0.837094 | 400.3240 | 30.123 | 1.009781 | 400.3530 | 28.306 | 0.968505 |
| 401.4850 | 28.589 | 0.813555 | 401.3490 | 29.102 | 0.993655 | 401.3810 | 27.314 | 0.933496 |
| 402.5100 | 27.780 | 0.761669 | 402.3710 | 28.118 | 0.942717 | 402.4010 | 26.361 | 0.870851 |
| 403.5380 | 27.024 | 0.774659 | 403.3960 | 27.186 | 0.885421 | 403.4240 | 25.458 | 0.829843 |
| 404.5450 | 26.294 | 0.656376 | 404.4180 | 26.290 | 0.804426 | 404.4580 | 24.597 | 0.808208 |
| 405.5760 | 25.621 | 0.642816 | 405.4470 | 25.439 | 0.828685 | 405.4790 | 23.778 | 0.773537 |
| 406.5990 | 24.978 | 0.615898 | 406.4720 | 24.624 | 0.733135 | 406.5060 | 23.001 | 0.708865 |
| 407.6120 | 24.376 | 0.572015 | 407.4960 | 23.850 | 0.738998 | 407.5420 | 22.269 | 0.717754 |
| 408.6370 | 23.804 | 0.528876 | 408.5250 | 23.112 | 0.676982 | 408.5760 | 21.572 | 0.655233 |
| 409.6640 | 23.271 | 0.492051 | 409.5500 | 22.417 | 0.663662 | 409.6020 | 20.916 | 0.645337 |
| 410.6820 | 22.767 | 0.474303 | 410.5750 | 21.763 | 0.629692 | 410.6250 | 20.295 | 0.570133 |
| 411.6980 | 22.297 | 0.434976 | 411.5950 | 21.139 | 0.596105 | 411.6520 | 19.707 | 0.577674 |
| 412.7140 | 21.861 | 0.416934 | 412.6270 | 20.552 | 0.560701 | 412.6750 | 19.163 | 0.507530 |
| 413.7320 | 21.441 | 0.384261 | 413.6470 | 20.008 | 0.506823 | 413.6930 | 18.654 | 0.469030 |
| 414.7610 | 21.054 | 0.361992 | 414.6710 | 19.488 | 0.491222 | 414.7230 | 18.177 | 0.443170 |
| 415.7760 | 20.689 | 0.351603 | 415.6970 | 19.003 | 0.470105 | 415.7520 | 17.734 | 0.431857 |
| 416.7840 | 20.348 | 0.313974 | 416.7160 | 18.545 | 0.430838 | 416.7740 | 17.320 | 0.397360 |
| 417.8110 | 20.025 | 0.304164 | 417.7420 | 18.112 | 0.406197 | 417.7990 | 16.940 | 0.364976 |
| 418.8280 | 19.724 | 0.292843 | 418.7680 | 17.712 | 0.389140 | 418.8150 | 16.583 | 0.341373 |
| 419.8430 | 19.441 | 0.274560 | 419.7820 | 17.337 | 0.343758 | 419.8380 | 16.252 | 0.312669 |
| 420.8590 | 19.172 | 0.256063 | 420.8070 | 16.986 | 0.336174 | 420.8550 | 15.938 | 0.299092 |
| 421.8790 | 18.919 | 0.235022 | 421.8270 | 16.658 | 0.308518 | 421.8750 | 15.648 | 0.258554 |
| 422.8940 | 18.681 | 0.227639 | 422.8450 | 16.351 | 0.292876 | 422.9030 | 15.376 | 0.280329 |
| 423.9040 | 18.456 | 0.206182 | 423.8570 | 16.062 | 0.266550 | 423.9130 | 15.119 | 0.244492 |
| 424.9160 | 18.240 | 0.202114 | 424.8760 | 15.789 | 0.263345 | 424.9370 | 14.876 | 0.230492 |
| 425.9390 | 18.031 | 0.184835 | 425.9030 | 15.533 | 0.257270 | 425.9500 | 14.644 | 0.216140 |
| 426.9450 | 17.850 | 0.177686 | 426.9110 | 15.287 | 0.231079 | 426.9680 | 14.428 | 0.210821 |
| 427.9650 | 17.669 | 0.185446 | 427.9330 | 15.057 | 0.222664 | 427.9840 | 14.217 | 0.192679 |
| 428.9730 | 17.494 | 0.168580 | 428.9460 | 14.842 | 0.204024 | 429.0050 | 14.025 | 0.192131 |
| 429.9890 | 17.327 | 0.155529 | 429.9630 | 14.639 | 0.206160 | 430.0140 | 13.839 | 0.184187 |
| 431.0050 | 17.170 | 0.150931 | 430.9760 | 14.440 | 0.190301 | 431.0240 | 13.660 | 0.171533 |
| 432.0130 | 17.017 | 0.154268 | 431.9850 | 14.252 | 0.177588 | 432.0280 | 13.489 | 0.155764 |
| 433.0240 | 16.870 | 0.130464 | 433.0020 | 14.074 | 0.176950 | 433.0510 | 13.324 | 0.158205 |

Table C-4: Continued

| 1wt% Silica in Cross-Linked PMMA (10C/min) | | | 3wt% Silica in Cross-Linked PMMA (10C/min) | | | 5wt% Silica in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 434.0420 | 16.737 | 0.135216 | 434.0180 | 13.903 | 0.161590 | 434.0660 | 13.167 | 0.151609 |
| 435.0560 | 16.600 | 0.129063 | 435.0230 | 13.742 | 0.150707 | 435.0750 | 13.013 | 0.149699 |
| 436.0610 | 16.473 | 0.125570 | 436.0410 | 13.584 | 0.141152 | 436.0860 | 12.863 | 0.142393 |
| 437.0770 | 16.349 | 0.116361 | 437.0510 | 13.445 | 0.135369 | 437.1090 | 12.719 | 0.142418 |
| 438.0910 | 16.235 | 0.113711 | 438.0720 | 13.306 | 0.134130 | 438.1140 | 12.581 | 0.131446 |
| 439.0960 | 16.121 | 0.110201 | 439.0820 | 13.175 | 0.128776 | 439.1290 | 12.448 | 0.131370 |
| 440.1070 | 16.011 | 0.106852 | 440.0900 | 13.049 | 0.117039 | 440.1370 | 12.319 | 0.126816 |
| 441.1110 | 15.908 | 0.098211 | 441.1000 | 12.929 | 0.113724 | 441.1570 | 12.194 | 0.120448 |
| 442.1310 | 15.807 | 0.095937 | 442.1180 | 12.813 | 0.115118 | 442.1630 | 12.072 | 0.117996 |
| 443.1450 | 15.714 | 0.101542 | 443.1300 | 12.703 | 0.104561 | 443.1720 | 11.953 | 0.110396 |
| 444.1530 | 15.615 | 0.088446 | 444.1400 | 12.600 | 0.099699 | 444.1800 | 11.842 | 0.108183 |
| 445.1610 | 15.538 | 0.079472 | 445.1540 | 12.505 | 0.082328 | 445.1850 | 11.734 | 0.098962 |
| 446.1630 | 15.455 | 0.075658 | 446.1700 | 12.421 | 0.082222 | 446.2020 | 11.633 | 0.103376 |
| 447.1780 | 15.378 | 0.068125 | 447.1740 | 12.337 | 0.080030 | 447.2040 | 11.533 | 0.094135 |
| 448.1870 | 15.308 | 0.070181 | 448.1840 | 12.255 | 0.075034 | 448.2200 | 11.440 | 0.089184 |
| 449.1940 | 15.240 | 0.062010 | 449.1920 | 12.186 | 0.065012 | 449.2340 | 11.349 | 0.093519 |
| 450.2120 | 15.169 | 0.073487 | 450.2050 | 12.115 | 0.071603 | 450.2370 | 11.262 | 0.083055 |
| 451.2160 | 15.103 | 0.047404 | 451.2140 | 12.050 | 0.060319 | 451.2410 | 11.181 | 0.080724 |
| 452.2280 | 15.052 | 0.055245 | 452.2240 | 11.991 | 0.052424 | 452.2470 | 11.104 | 0.068499 |
| 453.2320 | 14.995 | 0.056446 | 453.2330 | 11.943 | 0.045429 | 453.2610 | 11.035 | 0.065441 |
| 454.2460 | 14.943 | 0.048925 | 454.2400 | 11.899 | 0.043988 | 454.2720 | 10.966 | 0.065243 |
| 455.2600 | 14.896 | 0.046784 | 455.2510 | 11.854 | 0.041211 | 455.2840 | 10.903 | 0.054910 |
| 456.2620 | 14.850 | 0.039584 | 456.2660 | 11.814 | 0.041592 | 456.2880 | 10.845 | 0.059443 |
| 457.2720 | 14.809 | 0.050981 | 457.2770 | 11.775 | 0.033043 | 457.3000 | 10.789 | 0.049766 |
| 458.2840 | 14.767 | 0.036035 | 458.2830 | 11.740 | 0.035073 | 458.3160 | 10.736 | 0.049850 |
| 459.2980 | 14.736 | 0.034271 | 459.2980 | 11.705 | 0.031191 | 459.3210 | 10.689 | 0.044400 |
| 460.3010 | 14.703 | 0.028467 | 460.3030 | 11.673 | 0.023580 | 460.3330 | 10.647 | 0.041937 |
| 461.3060 | 14.675 | 0.029261 | 461.3230 | 11.653 | 0.021040 | 461.3400 | 10.606 | 0.027385 |
| 462.3100 | 14.644 | 0.032111 | 462.3270 | 11.629 | 0.024854 | 462.3530 | 10.574 | 0.036329 |
| 463.3170 | 14.618 | 0.015289 | 463.3380 | 11.603 | 0.026587 | 463.3530 | 10.537 | 0.032766 |
| 464.3320 | 14.599 | 0.035997 | 464.3440 | 11.579 | 0.021082 | 464.3640 | 10.506 | 0.029525 |
| 465.3410 | 14.567 | 0.022143 | 465.3580 | 11.556 | 0.020641 | 465.3770 | 10.474 | 0.032486 |
| 466.3460 | 14.553 | 0.016426 | 466.3630 | 11.541 | 0.014591 | 466.3830 | 10.446 | 0.020369 |
| 467.3540 | 14.530 | 0.025363 | 467.3710 | 11.521 | 0.024624 | 467.3880 | 10.426 | 0.023924 |
| 468.3520 | 14.509 | 0.016255 | 468.3820 | 11.501 | 0.019547 | 468.3950 | 10.403 | 0.020248 |
| 469.3640 | 14.486 | 0.029085 | 469.3960 | 11.480 | 0.017860 | 469.4020 | 10.384 | 0.017395 |
| 470.3740 | 14.466 | 0.004156 | 470.3970 | 11.467 | 0.012726 | 470.4070 | 10.364 | 0.024438 |
| 471.3800 | 14.450 | 0.025005 | 471.4060 | 11.454 | 0.015241 | 471.4140 | 10.342 | 0.018967 |
| 472.3930 | 14.427 | 0.005883 | 472.4060 | 11.437 | 0.016974 | 472.4220 | 10.325 | 0.017980 |
| 473.3940 | 14.414 | 0.016882 | 473.4120 | 11.424 | 0.013715 | 473.4290 | 10.308 | 0.014366 |
| 474.3960 | 14.397 | 0.004395 | 474.4200 | 11.406 | 0.020899 | 474.4350 | 10.293 | 0.018317 |
| 475.4130 | 14.391 | 0.017393 | 475.4240 | 11.389 | 0.015828 | 475.4470 | 10.275 | 0.014676 |
| 476.4120 | 14.369 | 0.013246 | 476.4300 | 11.381 | 0.004514 | 476.4460 | 10.265 | 0.013342 |
| 477.4180 | 14.361 | 0.009059 | 477.4390 | 11.373 | 0.013955 | 477.4650 | 10.250 | 0.013146 |
| 478.4310 | 14.345 | 0.020997 | 478.4420 | 11.359 | 0.011692 | 478.4710 | 10.235 | 0.018791 |
| 479.4380 | 14.334 | 0.005344 | 479.4480 | 11.349 | 0.009863 | 479.4780 | 10.222 | 0.015418 |
| 480.4480 | 14.323 | 0.024622 | 480.4550 | 11.341 | 0.007913 | 480.4870 | 10.207 | 0.003926 |
| 481.4500 | 14.305 | 0.013908 | 481.4680 | 11.331 | 0.009903 | 481.4970 | 10.199 | 0.012264 |
| 482.4570 | 14.297 | 0.010371 | 482.4690 | 11.320 | 0.017406 | 482.5070 | 10.187 | 0.006852 |
| 483.4590 | 14.281 | 0.018387 | 483.4820 | 11.306 | 0.005996 | 483.5060 | 10.175 | 0.011523 |
| 484.4700 | 14.267 | -0.003343 | 484.4870 | 11.299 | 0.015761 | 484.5130 | 10.163 | 0.012782 |
| 485.4770 | 14.263 | 0.010528 | 485.5000 | 11.291 | 0.003561 | 485.5300 | 10.153 | 0.010331 |
| 486.4820 | 14.251 | 0.011657 | 486.5030 | 11.282 | 0.017380 | 486.5300 | 10.145 | 0.007177 |
| 487.4890 | 14.241 | 0.015491 | 487.5030 | 11.272 | 0.005796 | 487.5370 | 10.136 | 0.008094 |
| 488.4890 | 14.229 | 0.001761 | 488.5180 | 11.268 | 0.000097 | 488.5400 | 10.128 | 0.012409 |
| 489.5030 | 14.226 | 0.008425 | 489.5210 | 11.263 | 0.012838 | 489.5470 | 10.117 | 0.008920 |
| 490.5030 | 14.216 | 0.014945 | 490.5320 | 11.249 | 0.000011 | 490.5630 | 10.110 | 0.007511 |
| 491.5100 | 14.205 | 0.008159 | 491.5340 | 11.248 | 0.006105 | 491.5590 | 10.101 | 0.005411 |
| 492.5130 | 14.200 | 0.002395 | 492.5410 | 11.239 | 0.007319 | 492.5670 | 10.093 | 0.010095 |
| 493.5170 | 14.196 | 0.005446 | 493.5460 | 11.226 | 0.013790 | 493.5790 | 10.084 | 0.007456 |
| 494.5240 | 14.190 | 0.006649 | 494.5580 | 11.216 | 0.007025 | 494.5800 | 10.079 | 0.002370 |
| 495.5310 | 14.176 | 0.016135 | 495.5630 | 11.213 | -0.000045 | 495.5910 | 10.073 | 0.010155 |
| 496.5380 | 14.170 | -0.000025 | 496.5690 | 11.211 | 0.004622 | 496.5880 | 10.063 | 0.007469 |
| 497.5470 | 14.166 | 0.014945 | 497.5770 | 11.206 | 0.001156 | 497.6060 | 10.057 | 0.005079 |
| 498.5460 | 14.151 | 0.003469 | 498.5820 | 11.201 | 0.011961 | 498.6060 | 10.052 | 0.008646 |
| 499.5600 | 14.149 | 0.013604 | 499.5860 | 11.191 | 0.000828 | 499.6160 | 10.047 | 0.002494 |

Table C-4: Continued

| 1wt% Silica in Cross-Linked PMMA (10C/min) | | | 3wt% Silica in Cross-Linked PMMA (10C/min) | | | 5wt% Silica in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 500.5600 | 14.141 | 0.003529 | 500.5980 | 11.188 | 0.005333 | 500.6240 | 10.040 | 0.008621 |
| 501.5770 | 14.139 | 0.010233 | 501.6030 | 11.183 | 0.007790 | 501.6310 | 10.035 | 0.003549 |
| 502.5780 | 14.129 | 0.005120 | 502.6080 | 11.169 | 0.008820 | 502.6340 | 10.033 | 0.005785 |
| 503.5800 | 14.127 | -0.005103 | 503.6150 | 11.169 | -0.002910 | 503.6400 | 10.028 | 0.007889 |
| 504.5930 | 14.125 | 0.007765 | 504.6190 | 11.165 | 0.010309 | 504.6450 | 10.022 | 0.004651 |
| 505.5960 | 14.117 | 0.006377 | 505.6310 | 11.160 | 0.004566 | 505.6550 | 10.015 | 0.004357 |

Table C-5: TGA and DTG for 1wt%, 3wt%, and 5wt% Silica in Linear PMMA

| 1wt% Silica in Linear PMMA (10C/min) | | | 3wt% Silica in Linear PMMA (10C/min) | | | 5wt% Silica in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 100.1380 | 100.000 | -0.001041 | 100.0300 | 100.000 | 0.005400 | 100.1360 | 100.000 | 0.004960 |
| 101.1050 | 100.003 | -0.000968 | 101.0130 | 100.000 | -0.002072 | 101.1030 | 100.000 | -0.001127 |
| 102.0930 | 100.004 | -0.001059 | 101.9840 | 100.003 | -0.006160 | 102.0850 | 99.997 | 0.004692 |
| 103.0760 | 100.008 | -0.001058 | 102.9770 | 100.009 | -0.003623 | 103.0730 | 99.995 | -0.001245 |
| 104.0610 | 100.005 | -0.000893 | 103.9520 | 100.010 | -0.003413 | 104.0590 | 99.992 | 0.004865 |
| 105.0540 | 100.006 | 0.003993 | 104.9430 | 100.013 | -0.000810 | 105.0430 | 99.989 | -0.001224 |
| 106.0390 | 100.005 | 0.003963 | 105.9240 | 100.015 | -0.006381 | 106.0300 | 99.988 | 0.004778 |
| 107.0290 | 100.004 | -0.001086 | 106.9210 | 100.017 | 0.004410 | 107.0110 | 99.977 | 0.010526 |
| 108.0100 | 100.004 | 0.004244 | 107.8980 | 100.013 | -0.004010 | 108.0030 | 99.973 | 0.005179 |
| 108.9950 | 100.002 | 0.003688 | 108.9010 | 100.017 | -0.005759 | 108.9910 | 99.969 | -0.001196 |
| 109.9940 | 99.999 | -0.000915 | 109.8750 | 100.020 | 0.001412 | 109.9830 | 99.967 | 0.004836 |
| 110.9800 | 100.001 | -0.000956 | 110.8750 | 100.018 | -0.000347 | 110.9810 | 99.961 | 0.011222 |
| 111.9790 | 99.996 | 0.003822 | 111.8630 | 100.019 | -0.000109 | 111.9720 | 99.949 | 0.017128 |
| 112.9710 | 99.995 | -0.001051 | 112.8550 | 100.020 | 0.000640 | 112.9660 | 99.944 | -0.001275 |
| 113.9700 | 99.994 | 0.004013 | 113.8450 | 100.021 | -0.000247 | 113.9610 | 99.934 | 0.017169 |
| 114.9630 | 99.991 | -0.000928 | 114.8430 | 100.019 | 0.003529 | 114.9470 | 99.926 | -0.001140 |
| 115.9600 | 99.987 | 0.008069 | 115.8380 | 100.016 | 0.003231 | 115.9510 | 99.925 | 0.010695 |
| 116.9570 | 99.983 | -0.000639 | 116.8400 | 100.020 | -0.008142 | 116.9470 | 99.914 | 0.011149 |
| 117.9710 | 99.980 | 0.008342 | 117.8410 | 100.021 | 0.006150 | 117.9550 | 99.904 | 0.010619 |
| 118.9870 | 99.974 | 0.003597 | 118.8420 | 100.017 | -0.000633 | 118.9540 | 99.891 | 0.016043 |
| 120.0010 | 99.970 | 0.003918 | 119.8390 | 100.015 | 0.003429 | 119.9670 | 99.879 | 0.010430 |
| 121.0040 | 99.967 | 0.003728 | 120.8420 | 100.011 | 0.005257 | 120.9740 | 99.868 | 0.015895 |
| 122.0080 | 99.963 | 0.003866 | 121.8380 | 100.009 | -0.001933 | 122.0030 | 99.850 | 0.011160 |
| 123.0290 | 99.959 | 0.003821 | 122.8460 | 100.008 | 0.002942 | 123.0140 | 99.841 | 0.004896 |
| 124.0430 | 99.956 | 0.003955 | 123.8450 | 100.005 | 0.003143 | 124.0350 | 99.835 | 0.011267 |
| 125.0570 | 99.954 | 0.003731 | 124.8590 | 100.001 | 0.004868 | 125.0480 | 99.823 | 0.009958 |
| 126.0680 | 99.951 | -0.000823 | 125.8590 | 99.996 | 0.004812 | 126.0700 | 99.814 | 0.016039 |
| 127.0850 | 99.948 | 0.003732 | 126.8760 | 99.991 | 0.001485 | 127.0940 | 99.803 | 0.004668 |
| 128.1050 | 99.947 | 0.003909 | 127.8830 | 99.988 | 0.004202 | 128.1140 | 99.797 | 0.010612 |
| 129.1220 | 99.947 | -0.000984 | 128.9050 | 99.983 | 0.008958 | 129.1240 | 99.786 | 0.004583 |
| 130.1390 | 99.945 | 0.003819 | 129.9230 | 99.974 | 0.001883 | 130.1290 | 99.782 | 0.010201 |
| 131.1580 | 99.944 | -0.005876 | 130.9320 | 99.971 | 0.004072 | 131.1520 | 99.771 | 0.004750 |
| 132.1580 | 99.943 | -0.001109 | 131.9590 | 99.969 | -0.001109 | 132.1590 | 99.763 | 0.004579 |
| 133.1630 | 99.945 | -0.000818 | 132.9740 | 99.969 | 0.000655 | 133.1630 | 99.763 | -0.001012 |
| 134.1780 | 99.941 | 0.003775 | 133.9900 | 99.965 | 0.003938 | 134.1660 | 99.757 | 0.004589 |
| 135.1810 | 99.943 | -0.000872 | 135.0100 | 99.959 | 0.004342 | 135.1820 | 99.759 | -0.001138 |
| 136.1930 | 99.941 | -0.001152 | 136.0300 | 99.955 | 0.002695 | 136.1820 | 99.753 | -0.001424 |
| 137.1910 | 99.941 | 0.003363 | 137.0400 | 99.951 | 0.004410 | 137.1820 | 99.750 | 0.004331 |
| 138.2050 | 99.939 | 0.003934 | 138.0490 | 99.948 | 0.004218 | 138.1960 | 99.748 | -0.000975 |
| 139.2110 | 99.942 | -0.000643 | 139.0660 | 99.944 | 0.002440 | 139.2020 | 99.741 | 0.011149 |
| 140.2110 | 99.942 | -0.000973 | 140.0740 | 99.948 | -0.007141 | 140.2110 | 99.734 | -0.001231 |
| 141.2320 | 99.942 | -0.000832 | 141.0840 | 99.951 | 0.000524 | 141.2200 | 99.731 | 0.005261 |
| 142.2320 | 99.940 | 0.003709 | 142.0950 | 99.947 | 0.001261 | 142.2280 | 99.731 | -0.001174 |
| 143.2350 | 99.940 | -0.001102 | 143.0970 | 99.944 | 0.008541 | 143.2340 | 99.727 | 0.004635 |
| 144.2420 | 99.940 | -0.005387 | 144.1150 | 99.937 | -0.000692 | 144.2480 | 99.725 | 0.004949 |
| 145.2600 | 99.944 | 0.003844 | 145.1260 | 99.940 | -0.001022 | 145.2530 | 99.721 | 0.004807 |
| 146.2730 | 99.942 | 0.003775 | 146.1270 | 99.939 | 0.003980 | 146.2610 | 99.720 | 0.010379 |
| 147.2790 | 99.938 | -0.000966 | 147.1350 | 99.935 | 0.004392 | 147.2730 | 99.712 | -0.001230 |
| 148.2920 | 99.940 | -0.000871 | 148.1620 | 99.933 | 0.000161 | 148.2930 | 99.709 | 0.010759 |
| 149.2970 | 99.940 | -0.005080 | 149.1760 | 99.933 | -0.003200 | 149.3030 | 99.702 | -0.007231 |
| 150.3180 | 99.938 | 0.003709 | 150.1870 | 99.936 | 0.002589 | 150.3180 | 99.699 | 0.010639 |
| 151.3280 | 99.936 | -0.000857 | 151.2050 | 99.931 | 0.003208 | 151.3330 | 99.692 | 0.005017 |
| 152.3390 | 99.935 | 0.003911 | 152.2130 | 99.927 | 0.012532 | 152.3380 | 99.691 | 0.004723 |
| 153.3570 | 99.933 | 0.003661 | 153.2340 | 99.918 | 0.002065 | 153.3610 | 99.687 | 0.004841 |
| 154.3720 | 99.931 | -0.000883 | 154.2440 | 99.918 | 0.005262 | 154.3710 | 99.678 | 0.004535 |
| 155.3950 | 99.932 | 0.004000 | 155.2640 | 99.918 | 0.000710 | 155.3890 | 99.673 | 0.004804 |
| 156.4000 | 99.928 | 0.003754 | 156.2740 | 99.915 | 0.004415 | 156.4150 | 99.666 | -0.001044 |
| 157.4230 | 99.928 | -0.001060 | 157.3050 | 99.914 | 0.001624 | 157.4180 | 99.665 | 0.004444 |
| 158.4460 | 99.926 | 0.003775 | 158.3200 | 99.912 | 0.001937 | 158.4430 | 99.655 | 0.010452 |
| 159.4620 | 99.923 | 0.003707 | 159.3380 | 99.910 | 0.007457 | 159.4720 | 99.647 | 0.011022 |
| 160.4830 | 99.919 | 0.003556 | 160.3520 | 99.899 | 0.004696 | 160.4760 | 99.637 | 0.010226 |
| 161.5020 | 99.915 | 0.003598 | 161.3780 | 99.895 | 0.004719 | 161.5040 | 99.627 | 0.016165 |
| 162.5130 | 99.913 | 0.003843 | 162.4050 | 99.889 | 0.006245 | 162.5260 | 99.617 | 0.005045 |
| 163.5340 | 99.910 | 0.003797 | 163.4140 | 99.885 | 0.001938 | 163.5370 | 99.610 | 0.010695 |
| 164.5540 | 99.906 | 0.008562 | 164.4400 | 99.885 | 0.003553 | 164.5580 | 99.599 | -0.000988 |
| 165.5760 | 99.899 | 0.008456 | 165.4570 | 99.875 | 0.010218 | 165.5710 | 99.597 | 0.010155 |

Table C-5: Continued

| 1wt% Silica in Linear PMMA (10C/min) | | | 3wt% Silica in Linear PMMA (10C/min) | | | 5wt% Silica in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 166.5990 | 99.895 | -0.000860 | 166.4860 | 99.868 | 0.008108 | 166.5970 | 99.582 | 0.016584 |
| 167.6120 | 99.892 | 0.008352 | 167.5030 | 99.861 | 0.004578 | 167.6250 | 99.570 | 0.010956 |
| 168.6400 | 99.883 | 0.003933 | 168.5160 | 99.855 | 0.011515 | 168.6360 | 99.560 | 0.010585 |
| 169.6570 | 99.879 | 0.008507 | 169.5460 | 99.844 | 0.006155 | 169.6630 | 99.546 | 0.010639 |
| 170.6810 | 99.873 | 0.003644 | 170.5620 | 99.837 | 0.011006 | 170.6870 | 99.532 | 0.016598 |
| 171.7080 | 99.868 | 0.008053 | 171.5910 | 99.831 | 0.002099 | 171.7190 | 99.518 | 0.016742 |
| 172.7210 | 99.855 | 0.012906 | 172.6040 | 99.824 | 0.009722 | 172.7270 | 99.505 | 0.010331 |
| 173.7520 | 99.847 | 0.008325 | 173.6390 | 99.814 | 0.010673 | 173.7460 | 99.493 | 0.016417 |
| 174.7770 | 99.839 | 0.008171 | 174.6580 | 99.799 | 0.017408 | 174.7810 | 99.478 | 0.010463 |
| 175.7930 | 99.831 | 0.008369 | 175.6800 | 99.788 | 0.008365 | 175.8020 | 99.469 | 0.010716 |
| 176.8230 | 99.821 | 0.008694 | 176.7060 | 99.777 | 0.010542 | 176.8210 | 99.452 | 0.016501 |
| 177.8510 | 99.812 | 0.013057 | 177.7360 | 99.766 | 0.016014 | 177.8500 | 99.434 | 0.021829 |
| 178.8680 | 99.800 | 0.008379 | 178.7550 | 99.751 | 0.010388 | 178.8710 | 99.416 | 0.016556 |
| 179.8920 | 99.790 | 0.008179 | 179.7840 | 99.740 | 0.010214 | 179.8940 | 99.400 | 0.016002 |
| 180.9150 | 99.780 | 0.011860 | 180.8050 | 99.732 | 0.012463 | 180.9220 | 99.381 | 0.015413 |
| 181.9500 | 99.768 | 0.013386 | 181.8310 | 99.713 | 0.017009 | 181.9550 | 99.362 | 0.017046 |
| 182.9660 | 99.754 | 0.012575 | 182.8530 | 99.703 | 0.014917 | 182.9700 | 99.347 | 0.010591 |
| 183.9980 | 99.744 | 0.004003 | 183.8790 | 99.685 | 0.010488 | 183.9930 | 99.324 | 0.027707 |
| 185.0180 | 99.732 | 0.013215 | 184.9020 | 99.673 | 0.015663 | 185.0250 | 99.303 | 0.016931 |
| 186.0480 | 99.718 | 0.018921 | 185.9260 | 99.656 | 0.011861 | 186.0550 | 99.282 | 0.016799 |
| 187.0650 | 99.701 | 0.012697 | 186.9380 | 99.643 | 0.011287 | 187.0660 | 99.265 | 0.015706 |
| 188.0900 | 99.685 | 0.013114 | 187.9810 | 99.629 | 0.018771 | 188.1040 | 99.247 | 0.023361 |
| 189.1130 | 99.671 | 0.012853 | 189.0040 | 99.609 | 0.019045 | 189.1170 | 99.225 | 0.021065 |
| 190.1370 | 99.654 | 0.017262 | 190.0330 | 99.593 | 0.017173 | 190.1480 | 99.202 | 0.021845 |
| 191.1660 | 99.637 | 0.022084 | 191.0580 | 99.572 | 0.018263 | 191.1750 | 99.179 | 0.027466 |
| 192.1900 | 99.621 | 0.012960 | 192.0850 | 99.555 | 0.018597 | 192.1900 | 99.151 | 0.015660 |
| 193.2130 | 99.605 | 0.013398 | 193.1070 | 99.533 | 0.016066 | 193.2180 | 99.133 | 0.028333 |
| 194.2450 | 99.586 | 0.022861 | 194.1250 | 99.517 | 0.019807 | 194.2460 | 99.104 | 0.020754 |
| 195.2580 | 99.567 | 0.017622 | 195.1500 | 99.499 | 0.013626 | 195.2710 | 99.085 | 0.016911 |
| 196.2880 | 99.549 | 0.012969 | 196.1810 | 99.480 | 0.024242 | 196.2980 | 99.063 | 0.021411 |
| 197.3110 | 99.530 | 0.017311 | 197.2050 | 99.458 | 0.018746 | 197.3250 | 99.038 | 0.028447 |
| 198.3370 | 99.508 | 0.022235 | 198.2330 | 99.436 | 0.023808 | 198.3490 | 99.013 | 0.022586 |
| 199.3590 | 99.486 | 0.017115 | 199.2550 | 99.414 | 0.021700 | 199.3720 | 98.985 | 0.027466 |
| 200.3980 | 99.465 | 0.022499 | 200.2730 | 99.390 | 0.019880 | 200.3990 | 98.957 | 0.021559 |
| 201.4170 | 99.441 | 0.026156 | 201.3070 | 99.368 | 0.025395 | 201.4270 | 98.932 | 0.034692 |
| 202.4420 | 99.416 | 0.021598 | 202.3320 | 99.347 | 0.018160 | 202.4450 | 98.903 | 0.020692 |
| 203.4710 | 99.391 | 0.027129 | 203.3600 | 99.324 | 0.027851 | 203.4770 | 98.874 | 0.033537 |
| 204.5020 | 99.363 | 0.022084 | 204.3850 | 99.299 | 0.022769 | 204.5070 | 98.840 | 0.033343 |
| 205.5300 | 99.336 | 0.027545 | 205.4160 | 99.270 | 0.027983 | 205.5290 | 98.809 | 0.021043 |
| 206.5590 | 99.306 | 0.026393 | 206.4520 | 99.246 | 0.029400 | 206.5600 | 98.783 | 0.026088 |
| 207.5830 | 99.279 | 0.027268 | 207.4850 | 99.212 | 0.024723 | 207.5960 | 98.752 | 0.027438 |
| 208.6120 | 99.249 | 0.031751 | 208.4990 | 99.191 | 0.025532 | 208.6160 | 98.722 | 0.027035 |
| 209.6440 | 99.214 | 0.035374 | 209.5380 | 99.161 | 0.027424 | 209.6570 | 98.690 | 0.033068 |
| 210.6770 | 99.180 | 0.032402 | 210.5710 | 99.133 | 0.030686 | 210.6870 | 98.656 | 0.028334 |
| 211.7000 | 99.142 | 0.036502 | 211.5930 | 99.100 | 0.028841 | 211.7140 | 98.619 | 0.042324 |
| 212.7240 | 99.107 | 0.034526 | 212.6310 | 99.067 | 0.032222 | 212.7510 | 98.576 | 0.046283 |
| 213.7550 | 99.070 | 0.039188 | 213.6640 | 99.035 | 0.038001 | 213.7730 | 98.522 | 0.048214 |
| 214.7900 | 99.031 | 0.036668 | 214.6880 | 98.995 | 0.032312 | 214.8090 | 98.473 | 0.044024 |
| 215.8170 | 98.989 | 0.042792 | 215.7190 | 98.964 | 0.033340 | 215.8420 | 98.428 | 0.046503 |
| 216.8490 | 98.943 | 0.043836 | 216.7470 | 98.925 | 0.035185 | 216.8720 | 98.380 | 0.043527 |
| 217.8830 | 98.896 | 0.044941 | 217.7780 | 98.890 | 0.040886 | 217.8980 | 98.334 | 0.043559 |
| 218.9080 | 98.848 | 0.048411 | 218.8060 | 98.850 | 0.036241 | 218.9310 | 98.286 | 0.049384 |
| 219.9420 | 98.798 | 0.045405 | 219.8400 | 98.808 | 0.052903 | 219.9630 | 98.232 | 0.047834 |
| 220.9690 | 98.748 | 0.049826 | 220.8690 | 98.765 | 0.036533 | 220.9880 | 98.183 | 0.048224 |
| 222.0000 | 98.696 | 0.060301 | 221.8930 | 98.724 | 0.043555 | 222.0210 | 98.125 | 0.063847 |
| 223.0280 | 98.641 | 0.057044 | 222.9330 | 98.678 | 0.043863 | 223.0580 | 98.058 | 0.065996 |
| 224.0620 | 98.581 | 0.060256 | 223.9620 | 98.630 | 0.045288 | 224.0820 | 97.991 | 0.073441 |
| 225.0930 | 98.519 | 0.058979 | 224.9900 | 98.588 | 0.044149 | 225.1060 | 97.915 | 0.070730 |
| 226.1160 | 98.458 | 0.067410 | 226.0260 | 98.538 | 0.052520 | 226.1440 | 97.839 | 0.079906 |
| 227.1490 | 98.391 | 0.067066 | 227.0570 | 98.487 | 0.054611 | 227.1750 | 97.759 | 0.075581 |
| 228.1780 | 98.324 | 0.066639 | 228.0770 | 98.433 | 0.053953 | 228.2040 | 97.682 | 0.076866 |
| 229.2130 | 98.256 | 0.066222 | 229.1120 | 98.379 | 0.050497 | 229.2340 | 97.606 | 0.075720 |
| 230.2370 | 98.184 | 0.081055 | 230.1420 | 98.328 | 0.051583 | 230.2660 | 97.529 | 0.078801 |
| 231.2620 | 98.109 | 0.080141 | 231.1730 | 98.270 | 0.055360 | 231.2800 | 97.451 | 0.075443 |
| 232.2940 | 98.028 | 0.076748 | 232.1900 | 98.214 | 0.054130 | 232.3080 | 97.371 | 0.077239 |
| 233.3240 | 97.947 | 0.082942 | 233.2310 | 98.154 | 0.055446 | 233.3430 | 97.289 | 0.079411 |

Table C-5: Continued

| 1wt% Silica in Linear PMMA (10C/min) | | | 3wt% Silica in Linear PMMA (10C/min) | | | 5wt% Silica in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 234.3440 | 97.858 | 0.086001 | 234.2620 | 98.096 | 0.061307 | 234.3670 | 97.205 | 0.080756 |
| 235.3750 | 97.772 | 0.080012 | 235.2820 | 98.033 | 0.058315 | 235.4050 | 97.121 | 0.082192 |
| 236.4060 | 97.686 | 0.085700 | 236.3110 | 97.971 | 0.062101 | 236.4360 | 97.034 | 0.086298 |
| 237.4380 | 97.589 | 0.100889 | 237.3430 | 97.906 | 0.062060 | 237.4610 | 96.953 | 0.079665 |
| 238.4690 | 97.485 | 0.120031 | 238.3660 | 97.842 | 0.062416 | 238.4990 | 96.866 | 0.081955 |
| 239.4970 | 97.330 | 0.168690 | 239.3970 | 97.777 | 0.066978 | 239.5210 | 96.785 | 0.074065 |
| 240.5260 | 97.182 | 0.128768 | 240.4260 | 97.709 | 0.066180 | 240.5570 | 96.704 | 0.085669 |
| 241.5550 | 97.058 | 0.112171 | 241.4540 | 97.639 | 0.073146 | 241.5770 | 96.618 | 0.083040 |
| 242.5820 | 96.937 | 0.114089 | 242.4910 | 97.564 | 0.069674 | 242.6110 | 96.532 | 0.082788 |
| 243.6110 | 96.816 | 0.122597 | 243.5170 | 97.490 | 0.100412 | 243.6350 | 96.448 | 0.079237 |
| 244.6520 | 96.667 | 0.172487 | 244.5480 | 97.375 | 0.108417 | 244.6630 | 96.362 | 0.085851 |
| 245.6820 | 96.471 | 0.187094 | 245.5820 | 97.262 | 0.096296 | 245.6890 | 96.273 | 0.078939 |
| 246.7070 | 96.294 | 0.162153 | 246.6110 | 97.173 | 0.083392 | 246.7240 | 96.186 | 0.092077 |
| 247.7290 | 96.106 | 0.235074 | 247.6380 | 97.083 | 0.095204 | 247.7550 | 96.096 | 0.079034 |
| 248.7630 | 95.894 | 0.189824 | 248.6710 | 96.981 | 0.129975 | 248.7870 | 96.015 | 0.091024 |
| 249.7880 | 95.705 | 0.202888 | 249.6980 | 96.829 | 0.159381 | 249.8080 | 95.926 | 0.077623 |
| 250.8180 | 95.494 | 0.206263 | 250.7190 | 96.656 | 0.161826 | 250.8430 | 95.845 | 0.086223 |
| 251.8450 | 95.285 | 0.196969 | 251.7470 | 96.499 | 0.142975 | 251.8760 | 95.760 | 0.078309 |
| 252.8680 | 95.077 | 0.206108 | 252.7790 | 96.350 | 0.144126 | 252.9000 | 95.677 | 0.088926 |
| 253.9060 | 94.866 | 0.207580 | 253.8000 | 96.204 | 0.143757 | 253.9290 | 95.593 | 0.083374 |
| 254.9330 | 94.643 | 0.241805 | 254.8360 | 96.045 | 0.153403 | 254.9580 | 95.506 | 0.091961 |
| 255.9530 | 94.412 | 0.209991 | 255.8590 | 95.884 | 0.157064 | 255.9880 | 95.412 | 0.095120 |
| 256.9850 | 94.205 | 0.209879 | 256.8820 | 95.720 | 0.152933 | 257.0060 | 95.309 | 0.118720 |
| 258.0140 | 93.994 | 0.206131 | 257.9090 | 95.561 | 0.153174 | 258.0430 | 95.172 | 0.129344 |
| 259.0460 | 93.790 | 0.206108 | 258.9470 | 95.404 | 0.152625 | 259.0690 | 95.050 | 0.116133 |
| 260.0700 | 93.578 | 0.203917 | 259.9750 | 95.251 | 0.145257 | 260.0980 | 94.930 | 0.120284 |
| 261.1000 | 93.371 | 0.199049 | 260.9930 | 95.104 | 0.140775 | 261.1230 | 94.816 | 0.110259 |
| 262.1210 | 93.166 | 0.189337 | 262.0250 | 94.955 | 0.146558 | 262.1550 | 94.699 | 0.105524 |
| 263.1490 | 92.971 | 0.181065 | 263.0540 | 94.801 | 0.143082 | 263.1780 | 94.593 | 0.105351 |
| 264.1830 | 92.782 | 0.190679 | 264.0690 | 94.652 | 0.138147 | 264.2040 | 94.482 | 0.106022 |
| 265.2130 | 92.596 | 0.176089 | 265.1060 | 94.502 | 0.144867 | 265.2330 | 94.377 | 0.107391 |
| 266.2360 | 92.418 | 0.172389 | 266.1330 | 94.360 | 0.137891 | 266.2590 | 94.268 | 0.100243 |
| 267.2620 | 92.252 | 0.159947 | 267.1620 | 94.216 | 0.145226 | 267.2880 | 94.157 | 0.108724 |
| 268.2920 | 92.087 | 0.153640 | 268.1910 | 94.078 | 0.133019 | 268.3140 | 94.047 | 0.104939 |
| 269.3150 | 91.931 | 0.149226 | 269.2180 | 93.940 | 0.124594 | 269.3370 | 93.942 | 0.104285 |
| 270.3500 | 91.782 | 0.151558 | 270.2410 | 93.810 | 0.125969 | 270.3570 | 93.827 | 0.113725 |
| 271.3800 | 91.637 | 0.140950 | 271.2700 | 93.678 | 0.118865 | 271.3850 | 93.713 | 0.103016 |
| 272.4060 | 91.493 | 0.139423 | 272.2940 | 93.552 | 0.120837 | 272.4220 | 93.599 | 0.106731 |
| 273.4260 | 91.357 | 0.128639 | 273.3270 | 93.431 | 0.107756 | 273.4540 | 93.489 | 0.109362 |
| 274.4660 | 91.221 | 0.125336 | 274.3620 | 93.320 | 0.107185 | 274.4770 | 93.374 | 0.116787 |
| 275.4860 | 91.098 | 0.121757 | 275.3840 | 93.215 | 0.103355 | 275.5050 | 93.257 | 0.120442 |
| 276.5160 | 90.973 | 0.118649 | 276.4060 | 93.110 | 0.096638 | 276.5210 | 93.139 | 0.118014 |
| 277.5420 | 90.855 | 0.107749 | 277.4280 | 93.012 | 0.097340 | 277.5480 | 93.010 | 0.146928 |
| 278.5680 | 90.736 | 0.111004 | 278.4550 | 92.906 | 0.096051 | 278.5670 | 92.864 | 0.133127 |
| 279.5970 | 90.621 | 0.104765 | 279.4870 | 92.813 | 0.088346 | 279.6000 | 92.734 | 0.127759 |
| 280.6280 | 90.510 | 0.106273 | 280.5130 | 92.729 | 0.079281 | 280.6200 | 92.597 | 0.137701 |
| 281.6570 | 90.400 | 0.112772 | 281.5420 | 92.648 | 0.083737 | 281.6460 | 92.452 | 0.136069 |
| 282.6790 | 90.291 | 0.097514 | 282.5660 | 92.567 | 0.076445 | 282.6740 | 92.306 | 0.143173 |
| 283.7030 | 90.187 | 0.099695 | 283.5950 | 92.487 | 0.076009 | 283.6950 | 92.156 | 0.138166 |
| 284.7330 | 90.081 | 0.099162 | 284.6120 | 92.415 | 0.071319 | 284.7180 | 92.013 | 0.136685 |
| 285.7620 | 89.974 | 0.102724 | 285.6500 | 92.340 | 0.071314 | 285.7480 | 91.870 | 0.135052 |
| 286.7780 | 89.871 | 0.099183 | 286.6700 | 92.269 | 0.077476 | 286.7750 | 91.729 | 0.139340 |
| 287.8120 | 89.770 | 0.101692 | 287.6910 | 92.195 | 0.069081 | 287.8010 | 91.591 | 0.144862 |
| 288.8320 | 89.670 | 0.096878 | 288.7080 | 92.132 | 0.060494 | 288.8200 | 91.439 | 0.151626 |
| 289.8490 | 89.570 | 0.096291 | 289.7410 | 92.070 | 0.060841 | 289.8400 | 91.284 | 0.135661 |
| 290.8780 | 89.468 | 0.100956 | 290.7650 | 92.004 | 0.068562 | 290.8650 | 91.138 | 0.140111 |
| 291.9050 | 89.365 | 0.096945 | 291.7850 | 91.936 | 0.066595 | 291.8900 | 90.991 | 0.135106 |
| 292.9250 | 89.260 | 0.106072 | 292.8090 | 91.870 | 0.058824 | 292.9250 | 90.838 | 0.158512 |
| 293.9530 | 89.154 | 0.104964 | 293.8400 | 91.808 | 0.065944 | 293.9380 | 90.684 | 0.132059 |
| 294.9730 | 89.043 | 0.103046 | 294.8550 | 91.742 | 0.065486 | 294.9600 | 90.542 | 0.142262 |
| 296.0010 | 88.934 | 0.109607 | 295.8790 | 91.678 | 0.065014 | 295.9920 | 90.396 | 0.135734 |
| 297.0230 | 88.817 | 0.111659 | 296.9030 | 91.612 | 0.064984 | 297.0170 | 90.258 | 0.132385 |
| 298.0510 | 88.701 | 0.116222 | 297.9210 | 91.545 | 0.064355 | 298.0340 | 90.120 | 0.131703 |
| 299.0650 | 88.582 | 0.116690 | 298.9560 | 91.475 | 0.073395 | 299.0590 | 89.982 | 0.132586 |
| 300.0930 | 88.459 | 0.123713 | 299.9720 | 91.404 | 0.070684 | 300.0920 | 89.843 | 0.137681 |

Table C-5: Continued

| 1wt% Silica in Linear PMMA (10C/min) | | | 3wt% Silica in Linear PMMA (10C/min) | | | 5wt% Silica in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 301.1130 | 88.334 | 0.123446 | 300.9870 | 91.334 | 0.069258 | 301.1170 | 89.708 | 0.137113 |
| 302.1320 | 88.205 | 0.128776 | 302.0120 | 91.260 | 0.074724 | 302.1290 | 89.569 | 0.136047 |
| 303.1570 | 88.071 | 0.145438 | 303.0320 | 91.184 | 0.081549 | 303.1600 | 89.431 | 0.142766 |
| 304.1790 | 87.932 | 0.148917 | 304.0500 | 91.103 | 0.085403 | 304.1740 | 89.292 | 0.140217 |
| 305.2010 | 87.786 | 0.146021 | 305.0720 | 91.016 | 0.085500 | 305.1880 | 89.148 | 0.144304 |
| 306.2110 | 87.642 | 0.143474 | 306.0950 | 90.929 | 0.090674 | 306.2180 | 88.996 | 0.142275 |
| 307.2310 | 87.492 | 0.142321 | 307.1160 | 90.833 | 0.090495 | 307.2420 | 88.854 | 0.148121 |
| 308.2540 | 87.334 | 0.149698 | 308.1330 | 90.740 | 0.097605 | 308.2560 | 88.709 | 0.141003 |
| 309.2680 | 87.178 | 0.152337 | 309.1600 | 90.633 | 0.104689 | 309.2760 | 88.564 | 0.144738 |
| 310.2890 | 87.012 | 0.158185 | 310.1790 | 90.525 | 0.120459 | 310.3020 | 88.414 | 0.142334 |
| 311.3130 | 86.847 | 0.166380 | 311.1940 | 90.406 | 0.117583 | 311.3240 | 88.268 | 0.152345 |
| 312.3390 | 86.671 | 0.171684 | 312.2190 | 90.281 | 0.128382 | 312.3410 | 88.117 | 0.148437 |
| 313.3530 | 86.497 | 0.195819 | 313.2340 | 90.151 | 0.125250 | 313.3620 | 87.969 | 0.143820 |
| 314.3700 | 86.308 | 0.189889 | 314.2540 | 90.016 | 0.138229 | 314.3780 | 87.812 | 0.152892 |
| 315.3920 | 86.117 | 0.198015 | 315.2770 | 89.873 | 0.153666 | 315.4000 | 87.653 | 0.163490 |
| 316.4050 | 85.919 | 0.202888 | 316.2970 | 89.714 | 0.163135 | 316.4220 | 87.487 | 0.171666 |
| 317.4230 | 85.715 | 0.200690 | 317.3170 | 89.549 | 0.174046 | 317.4480 | 87.317 | 0.171941 |
| 318.4380 | 85.500 | 0.216505 | 318.3360 | 89.378 | 0.172483 | 318.4570 | 87.141 | 0.171896 |
| 319.4570 | 85.275 | 0.221951 | 319.3420 | 89.193 | 0.184874 | 319.4740 | 86.959 | 0.178138 |
| 320.4810 | 85.033 | 0.242874 | 320.3630 | 89.000 | 0.191657 | 320.5030 | 86.768 | 0.197349 |
| 321.4980 | 84.782 | 0.256348 | 321.3830 | 88.797 | 0.207697 | 321.5150 | 86.576 | 0.203634 |
| 322.5100 | 84.513 | 0.272078 | 322.3950 | 88.580 | 0.217777 | 322.5290 | 86.367 | 0.204238 |
| 323.5270 | 84.235 | 0.283258 | 323.4140 | 88.349 | 0.238144 | 323.5460 | 86.152 | 0.210428 |
| 324.5430 | 83.943 | 0.305014 | 324.4240 | 88.100 | 0.240954 | 324.5690 | 85.927 | 0.236338 |
| 325.5520 | 83.630 | 0.303013 | 325.4410 | 87.835 | 0.265979 | 325.5770 | 85.689 | 0.236170 |
| 326.5720 | 83.295 | 0.333590 | 326.4660 | 87.554 | 0.297055 | 326.5940 | 85.439 | 0.252920 |
| 327.5820 | 82.943 | 0.363497 | 327.4750 | 87.256 | 0.301470 | 327.6170 | 85.175 | 0.282027 |
| 328.5950 | 82.574 | 0.373818 | 328.4940 | 86.938 | 0.343074 | 328.6300 | 84.898 | 0.286292 |
| 329.6100 | 82.185 | 0.401569 | 329.5070 | 86.600 | 0.342241 | 329.6390 | 84.601 | 0.297218 |
| 330.6200 | 81.770 | 0.451242 | 330.5110 | 86.240 | 0.353182 | 330.6570 | 84.285 | 0.322496 |
| 331.6310 | 81.335 | 0.441081 | 331.5290 | 85.857 | 0.386749 | 331.6800 | 83.951 | 0.332860 |
| 332.6410 | 80.874 | 0.482166 | 332.5420 | 85.448 | 0.420097 | 332.6860 | 83.596 | 0.366970 |
| 333.6470 | 80.384 | 0.500008 | 333.5490 | 85.013 | 0.440482 | 333.6990 | 83.220 | 0.379294 |
| 334.6540 | 79.866 | 0.538859 | 334.5660 | 84.547 | 0.493220 | 334.7090 | 82.827 | 0.388485 |
| 335.6710 | 79.313 | 0.536867 | 335.5820 | 84.043 | 0.516147 | 335.7200 | 82.406 | 0.433625 |
| 336.6760 | 78.739 | 0.617596 | 336.5890 | 83.515 | 0.532033 | 336.7290 | 81.956 | 0.453962 |
| 337.6810 | 78.125 | 0.611730 | 337.5980 | 82.952 | 0.575468 | 337.7370 | 81.479 | 0.500129 |
| 338.6900 | 77.480 | 0.671466 | 338.6100 | 82.354 | 0.598951 | 338.7540 | 80.977 | 0.532360 |
| 339.6990 | 76.798 | 0.727326 | 339.6240 | 81.724 | 0.647242 | 339.7590 | 80.444 | 0.543492 |
| 340.6950 | 76.082 | 0.735323 | 340.6140 | 81.054 | 0.667561 | 340.7630 | 79.884 | 0.580336 |
| 341.6990 | 75.330 | 0.746480 | 341.6350 | 80.344 | 0.739013 | 341.7700 | 79.287 | 0.596680 |
| 342.7060 | 74.533 | 0.811187 | 342.6400 | 79.590 | 0.749597 | 342.7780 | 78.667 | 0.635481 |
| 343.7100 | 73.702 | 0.845769 | 343.6370 | 78.805 | 0.787039 | 343.7860 | 77.998 | 0.666624 |
| 344.7050 | 72.830 | 0.853793 | 344.6520 | 77.971 | 0.873297 | 344.7900 | 77.294 | 0.760891 |
| 345.7100 | 71.917 | 0.891324 | 345.6630 | 77.102 | 0.904296 | 345.8010 | 76.546 | 0.781528 |
| 346.7130 | 70.964 | 0.951920 | 346.6720 | 76.189 | 0.966235 | 346.8000 | 75.768 | 0.779430 |
| 347.7130 | 69.971 | 0.987368 | 347.6610 | 75.228 | 0.979032 | 347.8040 | 74.951 | 0.840423 |
| 348.7160 | 68.942 | 1.052116 | 348.6780 | 74.229 | 1.038451 | 348.8050 | 74.097 | 0.844106 |
| 349.7130 | 67.870 | 1.118117 | 349.6750 | 73.191 | 1.093427 | 349.8190 | 73.211 | 0.935420 |
| 350.7100 | 66.755 | 1.152263 | 350.6770 | 72.122 | 1.070554 | 350.8200 | 72.281 | 0.985573 |
| 351.7030 | 65.591 | 1.128678 | 351.6810 | 71.012 | 1.140316 | 351.8160 | 71.307 | 1.024664 |
| 352.7010 | 64.384 | 1.238022 | 352.6830 | 69.863 | 1.184357 | 352.8210 | 70.293 | 1.034483 |
| 353.7000 | 63.138 | 1.212508 | 353.6860 | 68.674 | 1.227198 | 353.8220 | 69.235 | 1.091243 |
| 354.7000 | 61.851 | 1.231538 | 354.6860 | 67.444 | 1.234267 | 354.8270 | 68.135 | 1.122699 |
| 355.7040 | 60.528 | 1.396978 | 355.6950 | 66.180 | 1.293510 | 355.8240 | 67.001 | 1.164096 |
| 356.7000 | 59.152 | 1.354572 | 356.6940 | 64.878 | 1.334773 | 356.8320 | 65.818 | 1.186558 |
| 357.7010 | 57.734 | 1.462499 | 357.7010 | 63.550 | 1.353824 | 357.8300 | 64.578 | 1.265497 |
| 358.6970 | 56.287 | 1.419935 | 358.7010 | 62.188 | 1.400531 | 358.8290 | 63.301 | 1.286578 |
| 359.7030 | 54.834 | 1.457055 | 359.7050 | 60.801 | 1.344853 | 359.8390 | 62.000 | 1.320459 |
| 360.7070 | 53.363 | 1.440451 | 360.7080 | 59.390 | 1.439983 | 360.8460 | 60.652 | 1.432617 |
| 361.7080 | 51.874 | 1.501989 | 361.7100 | 57.964 | 1.454398 | 361.8430 | 59.285 | 1.392314 |
| 362.7140 | 50.357 | 1.511886 | 362.7150 | 56.515 | 1.403169 | 362.8440 | 57.912 | 1.337650 |
| 363.7210 | 48.822 | 1.513168 | 363.7200 | 55.048 | 1.434545 | 363.8580 | 56.509 | 1.422719 |
| 364.7280 | 47.250 | 1.587983 | 364.7210 | 53.561 | 1.413764 | 364.8620 | 55.094 | 1.448189 |
| 365.7390 | 45.673 | 1.536928 | 365.7360 | 52.063 | 1.515916 | 365.8640 | 53.654 | 1.404348 |

Table C-5: Continued

| 1wt% Silica in Linear PMMA (10C/min) | | | 3wt% Silica in Linear PMMA (10C/min) | | | 5wt% Silica in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 366.7500 | 44.111 | 1.593624 | 366.7420 | 50.561 | 1.443502 | 366.8760 | 52.226 | 1.447215 |
| 367.7410 | 42.545 | 1.545050 | 367.7570 | 49.048 | 1.482324 | 367.8880 | 50.783 | 1.466084 |
| 368.7540 | 40.974 | 1.527625 | 368.7670 | 47.539 | 1.507505 | 368.8960 | 49.328 | 1.468062 |
| 369.7620 | 39.393 | 1.597435 | 369.7790 | 46.032 | 1.461962 | 369.9010 | 47.868 | 1.491331 |
| 370.7650 | 37.790 | 1.645603 | 370.7910 | 44.535 | 1.522179 | 370.9080 | 46.396 | 1.464643 |
| 371.7850 | 36.184 | 1.570287 | 371.7990 | 43.034 | 1.476316 | 371.9120 | 44.907 | 1.515868 |
| 372.7840 | 34.575 | 1.607487 | 372.8170 | 41.549 | 1.456848 | 372.9270 | 43.389 | 1.516117 |
| 373.7970 | 32.979 | 1.627422 | 373.8340 | 40.079 | 1.456231 | 373.9430 | 41.889 | 1.444511 |
| 374.8030 | 31.410 | 1.533394 | 374.8470 | 38.635 | 1.401369 | 374.9620 | 40.413 | 1.394752 |
| 375.8260 | 29.852 | 1.484542 | 375.8710 | 37.208 | 1.396838 | 375.9710 | 38.968 | 1.337501 |
| 376.8450 | 28.322 | 1.512164 | 376.8850 | 35.799 | 1.333221 | 376.9970 | 37.541 | 1.413667 |
| 377.8660 | 26.837 | 1.458294 | 377.9090 | 34.418 | 1.364933 | 378.0170 | 36.147 | 1.351390 |
| 378.8890 | 25.368 | 1.399763 | 378.9250 | 33.066 | 1.329183 | 379.0400 | 34.772 | 1.332346 |
| 379.9230 | 23.958 | 1.347734 | 379.9520 | 31.752 | 1.284125 | 380.0610 | 33.444 | 1.302009 |
| 380.9520 | 22.610 | 1.291016 | 380.9690 | 30.465 | 1.218674 | 381.0840 | 32.160 | 1.191157 |
| 381.9810 | 21.303 | 1.257457 | 381.9960 | 29.221 | 1.229056 | 382.1090 | 30.929 | 1.130452 |
| 382.9990 | 20.041 | 1.153647 | 383.0100 | 28.015 | 1.077237 | 383.1390 | 29.756 | 1.086621 |
| 384.0360 | 18.849 | 1.114463 | 384.0450 | 26.859 | 1.139961 | 384.1730 | 28.646 | 1.026104 |
| 385.0750 | 17.718 | 1.041104 | 385.0700 | 25.746 | 1.094128 | 385.2030 | 27.601 | 0.982429 |
| 386.1070 | 16.660 | 0.960562 | 386.0900 | 24.690 | 1.021914 | 386.2440 | 26.615 | 0.951139 |
| 387.1470 | 15.682 | 0.838582 | 387.1190 | 23.686 | 0.920314 | 387.2760 | 25.687 | 0.879286 |
| 388.1890 | 14.791 | 0.773202 | 388.1520 | 22.740 | 0.912726 | 388.3090 | 24.819 | 0.854350 |
| 389.2390 | 13.973 | 0.744367 | 389.1720 | 21.845 | 0.818102 | 389.3420 | 24.005 | 0.777558 |
| 390.2800 | 13.226 | 0.691351 | 390.1990 | 21.002 | 0.785624 | 390.3820 | 23.241 | 0.738425 |
| 391.3230 | 12.538 | 0.602720 | 391.2370 | 20.208 | 0.738365 | 391.4090 | 22.541 | 0.640149 |
| 392.3660 | 11.915 | 0.564915 | 392.2680 | 19.467 | 0.678108 | 392.4420 | 21.891 | 0.598370 |
| 393.4110 | 11.345 | 0.504795 | 393.2980 | 18.780 | 0.643567 | 393.4680 | 21.289 | 0.524595 |
| 394.4510 | 10.835 | 0.469702 | 394.3300 | 18.146 | 0.591949 | 394.5070 | 20.734 | 0.507325 |
| 395.4850 | 10.377 | 0.408475 | 395.3540 | 17.557 | 0.557171 | 395.5350 | 20.224 | 0.440998 |
| 396.5260 | 9.967 | 0.356256 | 396.3910 | 17.013 | 0.494870 | 396.5710 | 19.758 | 0.446055 |
| 397.5700 | 9.605 | 0.326920 | 397.4180 | 16.511 | 0.463247 | 397.5990 | 19.325 | 0.367447 |
| 398.6050 | 9.285 | 0.295934 | 398.4450 | 16.054 | 0.422949 | 398.6340 | 18.937 | 0.357432 |
| 399.6390 | 9.000 | 0.274151 | 399.4750 | 15.640 | 0.377805 | 399.6610 | 18.574 | 0.341920 |
| 400.6730 | 8.747 | 0.228573 | 400.5040 | 15.262 | 0.367670 | 400.6900 | 18.244 | 0.311328 |
| 401.7080 | 8.523 | 0.211171 | 401.5210 | 14.921 | 0.299997 | 401.7170 | 17.938 | 0.276641 |
| 402.7380 | 8.324 | 0.184446 | 402.5570 | 14.611 | 0.277571 | 402.7450 | 17.662 | 0.259008 |
| 403.7600 | 8.149 | 0.162827 | 403.5860 | 14.335 | 0.259326 | 403.7700 | 17.407 | 0.234012 |
| 404.7930 | 7.993 | 0.146687 | 404.6140 | 14.083 | 0.224099 | 404.7900 | 17.179 | 0.219692 |
| 405.8190 | 7.858 | 0.124737 | 405.6360 | 13.861 | 0.204003 | 405.8150 | 16.964 | 0.194503 |
| 406.8450 | 7.736 | 0.113313 | 406.6560 | 13.665 | 0.170827 | 406.8400 | 16.772 | 0.183438 |
| 407.8630 | 7.629 | 0.099512 | 407.6780 | 13.490 | 0.159831 | 407.8590 | 16.594 | 0.168482 |
| 408.8860 | 7.533 | 0.086644 | 408.7080 | 13.331 | 0.147453 | 408.8820 | 16.437 | 0.147876 |
| 409.9100 | 7.450 | 0.075921 | 409.7230 | 13.188 | 0.129755 | 409.9040 | 16.294 | 0.137155 |
| 410.9270 | 7.378 | 0.064399 | 410.7430 | 13.064 | 0.115781 | 410.9210 | 16.156 | 0.136453 |
| 411.9450 | 7.312 | 0.061229 | 411.7600 | 12.954 | 0.100266 | 411.9340 | 16.033 | 0.112080 |
| 412.9680 | 7.256 | 0.049929 | 412.7830 | 12.857 | 0.081281 | 412.9600 | 15.925 | 0.095202 |
| 413.9820 | 7.206 | 0.045745 | 413.8010 | 12.775 | 0.078777 | 413.9760 | 15.826 | 0.101312 |
| 415.0000 | 7.161 | 0.038094 | 414.8180 | 12.697 | 0.070375 | 414.9950 | 15.726 | 0.084405 |
| 416.0140 | 7.123 | 0.038109 | 415.8340 | 12.629 | 0.060143 | 416.0140 | 15.644 | 0.081106 |
| 417.0300 | 7.088 | 0.028353 | 416.8530 | 12.571 | 0.048131 | 417.0300 | 15.566 | 0.070087 |
| 418.0450 | 7.060 | 0.025747 | 417.8690 | 12.520 | 0.048238 | 418.0430 | 15.499 | 0.060779 |
| 419.0610 | 7.034 | 0.022678 | 418.8800 | 12.475 | 0.041548 | 419.0610 | 15.436 | 0.062363 |
| 420.0700 | 7.013 | 0.018950 | 419.8970 | 12.430 | 0.044943 | 420.0740 | 15.375 | 0.057588 |
| 421.0880 | 6.993 | 0.019544 | 420.9190 | 12.391 | 0.040184 | 421.0890 | 15.321 | 0.052837 |
| 422.1050 | 6.977 | 0.017107 | 421.9330 | 12.352 | 0.037860 | 422.1100 | 15.268 | 0.049535 |
| 423.1060 | 6.961 | 0.014638 | 422.9540 | 12.322 | 0.029792 | 423.1220 | 15.221 | 0.044044 |
| 424.1210 | 6.947 | 0.017385 | 423.9650 | 12.293 | 0.026307 | 424.1310 | 15.177 | 0.042437 |
| 425.1430 | 6.933 | 0.011845 | 424.9850 | 12.267 | 0.027992 | 425.1440 | 15.132 | 0.045255 |
| 426.1510 | 6.926 | 0.008133 | 425.9900 | 12.240 | 0.020973 | 426.1590 | 15.091 | 0.034577 |
| 427.1610 | 6.916 | 0.010521 | 427.0140 | 12.217 | 0.026248 | 427.1740 | 15.060 | 0.028638 |
| 428.1640 | 6.907 | 0.007261 | 428.0230 | 12.191 | 0.020856 | 428.1860 | 15.024 | 0.036549 |
| 429.1780 | 6.899 | 0.007848 | 429.0360 | 12.169 | 0.020830 | 429.1940 | 14.992 | 0.023084 |
| 430.1840 | 6.891 | 0.005037 | 430.0470 | 12.151 | 0.011817 | 430.2100 | 14.961 | 0.032001 |
| 431.1980 | 6.888 | 0.002861 | 431.0660 | 12.138 | 0.013537 | 431.2220 | 14.932 | 0.024595 |
| 432.1990 | 6.882 | 0.009265 | 432.0730 | 12.123 | 0.025569 | 432.2360 | 14.904 | 0.028938 |
| 433.2160 | 6.873 | 0.007993 | 433.0820 | 12.099 | 0.014924 | 433.2400 | 14.881 | 0.019992 |

Table C-5: Continued

| 1wt% Silica in Linear PMMA (10C/min) | | | 3wt% Silica in Linear PMMA (10C/min) | | | 5wt% Silica in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 434.2230 | 6.868 | 0.003686 | 434.0920 | 12.085 | 0.020876 | 434.2660 | 14.858 | 0.026051 |
| 435.2270 | 6.864 | 0.005478 | 435.0990 | 12.069 | 0.010601 | 435.2620 | 14.833 | 0.021071 |
| 436.2350 | 6.858 | 0.003731 | 436.1090 | 12.061 | 0.011584 | 436.2750 | 14.812 | 0.021799 |
| 437.2490 | 6.855 | 0.001959 | 437.1170 | 12.048 | 0.014721 | 437.2860 | 14.793 | 0.016608 |
| 438.2580 | 6.851 | 0.003365 | 438.1300 | 12.035 | 0.007799 | 438.2950 | 14.776 | 0.016691 |
| 439.2630 | 6.848 | 0.001948 | 439.1400 | 12.026 | 0.012946 | 439.3020 | 14.760 | 0.019299 |
| 440.2670 | 6.843 | 0.007061 | 440.1410 | 12.013 | 0.005327 | 440.3170 | 14.738 | 0.018247 |
| 441.2820 | 6.837 | 0.001848 | 441.1540 | 12.006 | 0.011200 | 441.3280 | 14.724 | 0.011930 |
| 442.2890 | 6.836 | 0.001971 | 442.1590 | 11.996 | 0.004671 | 442.3330 | 14.711 | 0.010015 |
| 443.2950 | 6.834 | 0.002416 | 443.1640 | 11.987 | 0.010464 | 443.3410 | 14.698 | 0.015136 |
| 444.3020 | 6.831 | 0.004032 | 444.1760 | 11.979 | 0.003751 | 444.3520 | 14.682 | 0.010653 |
| 445.3130 | 6.829 | 0.003775 | 445.1820 | 11.970 | 0.009935 | 445.3630 | 14.673 | 0.011086 |
| 446.3210 | 6.825 | -0.000060 | 446.1940 | 11.961 | 0.011028 | 446.3780 | 14.659 | 0.011526 |
| 447.3210 | 6.825 | 0.003108 | 447.2000 | 11.951 | 0.002454 | 447.3790 | 14.648 | 0.013531 |
| 448.3320 | 6.821 | 0.001601 | 448.2010 | 11.952 | 0.000097 | 448.3910 | 14.637 | -0.000448 |
| 449.3390 | 6.821 | 0.001547 | 449.2110 | 11.948 | 0.004927 | 449.3970 | 14.630 | 0.015985 |
| 450.3400 | 6.817 | 0.004597 | 450.2300 | 11.939 | 0.012483 | 450.4030 | 14.615 | 0.004722 |
| 451.3530 | 6.814 | 0.000096 | 451.2280 | 11.928 | 0.006068 | 451.4140 | 14.612 | 0.001309 |
| 452.3610 | 6.812 | 0.001475 | 452.2280 | 11.923 | -0.000363 | 452.4250 | 14.607 | 0.014200 |
| 453.3690 | 6.811 | 0.000366 | 453.2340 | 11.925 | 0.004100 | 453.4250 | 14.597 | 0.007570 |
| 454.3760 | 6.807 | 0.002939 | 454.2480 | 11.919 | 0.000136 | 454.4350 | 14.590 | 0.011403 |
| 455.3800 | 6.808 | 0.001825 | 455.2480 | 11.917 | 0.004783 | 455.4430 | 14.580 | 0.005707 |
| 456.3870 | 6.804 | 0.004295 | 456.2580 | 11.911 | 0.003741 | 456.4450 | 14.575 | 0.006860 |
| 457.3950 | 6.803 | 0.004607 | 457.2570 | 11.907 | 0.005134 | 457.4640 | 14.568 | 0.004339 |
| 458.3990 | 6.798 | 0.002307 | 458.2640 | 11.906 | -0.002537 | 458.4620 | 14.563 | 0.005374 |
| 459.4100 | 6.800 | 0.002476 | 459.2700 | 11.904 | 0.014636 | 459.4710 | 14.552 | 0.011274 |
| 460.4180 | 6.795 | 0.001119 | 460.2810 | 11.899 | 0.000067 | 460.4840 | 14.548 | 0.000180 |
| 461.4280 | 6.796 | 0.003028 | 461.2860 | 11.896 | 0.006601 | 461.4970 | 14.545 | 0.010043 |
| 462.4370 | 6.792 | 0.000409 | 462.2900 | 11.896 | 0.001857 | 462.4950 | 14.540 | -0.000648 |
| 463.4450 | 6.794 | 0.002445 | 463.3050 | 11.892 | -0.000460 | 463.4980 | 14.538 | 0.005460 |
| 464.4530 | 6.789 | 0.001331 | 464.3110 | 11.887 | 0.009610 | 464.5160 | 14.533 | 0.005324 |
| 465.4560 | 6.789 | 0.004641 | 465.3050 | 11.882 | -0.014393 | 465.5220 | 14.529 | 0.000744 |
| 466.4630 | 6.786 | -0.001343 | 466.3210 | 11.889 | 0.003930 | 466.5180 | 14.528 | 0.001750 |
| 467.4670 | 6.786 | 0.007193 | 467.3240 | 11.885 | -0.005944 | 467.5280 | 14.522 | 0.003536 |
| 468.4670 | 6.783 | 0.000008 | 468.3270 | 11.883 | 0.007937 | 468.5280 | 14.519 | 0.005631 |
| 469.4790 | 6.783 | 0.002335 | 469.3330 | 11.876 | 0.004265 | 469.5420 | 14.515 | -0.001746 |
| 470.4870 | 6.781 | -0.000575 | 470.3350 | 11.872 | 0.001920 | 470.5500 | 14.514 | 0.008651 |
| 471.4900 | 6.782 | 0.003643 | 471.3480 | 11.874 | -0.000076 | 471.5600 | 14.505 | 0.002395 |
| 472.4960 | 6.779 | -0.001453 | 472.3510 | 11.872 | 0.001174 | 472.5680 | 14.503 | 0.007177 |
| 473.5050 | 6.779 | 0.011152 | 473.3550 | 11.871 | 0.003290 | 473.5730 | 14.497 | 0.003172 |
| 474.5080 | 6.775 | 0.000008 | 474.3700 | 11.868 | 0.004288 | 474.5780 | 14.494 | 0.002955 |
| 475.5140 | 6.775 | 0.004135 | 475.3740 | 11.866 | -0.000018 | 475.5850 | 14.490 | 0.001647 |
| 476.5230 | 6.774 | -0.001807 | 476.3710 | 11.865 | 0.003479 | 476.5920 | 14.492 | 0.003212 |
| 477.5240 | 6.775 | 0.001026 | 477.3800 | 11.862 | -0.001858 | 477.5950 | 14.484 | 0.007350 |
| 478.5260 | 6.773 | -0.000014 | 478.3870 | 11.865 | 0.000101 | 478.6010 | 14.486 | -0.002910 |
| 479.5340 | 6.770 | 0.004756 | 479.3880 | 11.862 | 0.004326 | 479.6010 | 14.486 | 0.005845 |
| 480.5440 | 6.767 | -0.001410 | 480.3910 | 11.858 | -0.000611 | 480.6090 | 14.481 | 0.006925 |
| 481.5490 | 6.766 | 0.005910 | 481.4010 | 11.857 | 0.000714 | 481.6200 | 14.477 | -0.004178 |
| 482.5510 | 6.766 | -0.004947 | 482.4040 | 11.855 | 0.001038 | 482.6280 | 14.476 | 0.003804 |
| 483.5600 | 6.765 | 0.006044 | 483.4100 | 11.856 | -0.000614 | 483.6260 | 14.472 | 0.004343 |
| 484.5730 | 6.761 | -0.001748 | 484.4180 | 11.853 | 0.000614 | 484.6360 | 14.466 | 0.003698 |
| 485.5760 | 6.762 | 0.002416 | 485.4260 | 11.855 | -0.000048 | 485.6390 | 14.467 | -0.001063 |
| 486.5740 | 6.759 | -0.001402 | 486.4290 | 11.851 | 0.000582 | 486.6460 | 14.461 | 0.009404 |
| 487.5840 | 6.760 | 0.000923 | 487.4430 | 11.849 | 0.004399 | 487.6520 | 14.459 | -0.005353 |
| 488.5960 | 6.759 | -0.002273 | 488.4440 | 11.843 | -0.000525 | 488.6550 | 14.461 | 0.005921 |
| 489.5940 | 6.759 | 0.001847 | 489.4410 | 11.843 | 0.002053 | 489.6630 | 14.457 | 0.000578 |
| 490.6020 | 6.757 | -0.003341 | 490.4500 | 11.844 | -0.005358 | 490.6660 | 14.458 | 0.003991 |
| 491.6100 | 6.757 | 0.005348 | 491.4550 | 11.843 | 0.003426 | 491.6780 | 14.452 | 0.004037 |
| 492.6110 | 6.754 | -0.001392 | 492.4570 | 11.842 | 0.001764 | 492.6800 | 14.454 | -0.002330 |
| 493.6150 | 6.754 | 0.001755 | 493.4680 | 11.839 | 0.001181 | 493.6820 | 14.451 | 0.002693 |
| 494.6210 | 6.753 | -0.003350 | 494.4720 | 11.841 | 0.006229 | 494.6890 | 14.446 | 0.005220 |
| 495.6310 | 6.755 | 0.001474 | 495.4730 | 11.835 | -0.000636 | 495.7010 | 14.442 | 0.002991 |
| 496.6360 | 6.754 | -0.003288 | 496.4860 | 11.839 | 0.009090 | 496.7050 | 14.440 | 0.001195 |
| 497.6410 | 6.755 | 0.002254 | 497.4880 | 11.836 | -0.002418 | 497.7140 | 14.440 | 0.003587 |
| 498.6500 | 6.753 | -0.003368 | 498.4920 | 11.838 | 0.009264 | 498.7150 | 14.433 | 0.008255 |
| 499.6510 | 6.753 | 0.001390 | 499.4980 | 11.837 | -0.003319 | 499.7180 | 14.430 | -0.000017 |

Table C-5: Continued

| 1wt% Silica in Linear PMMA (10C/min) | | | 3wt% Silica in Linear PMMA (10C/min) | | | 5wt% Silica in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 500.6580 | 6.753 | -0.007593 | 500.5000 | 11.836 | 0.002539 | 500.7210 | 14.431 | 0.001160 |
| 501.6650 | 6.754 | 0.002321 | 501.5090 | 11.833 | -0.002897 | 501.7300 | 14.427 | 0.005279 |
| 502.6740 | 6.752 | 0.001993 | 502.5210 | 11.837 | -0.001068 | 502.7290 | 14.422 | -0.000440 |
| 503.6800 | 6.749 | 0.002366 | 503.5240 | 11.838 | 0.001693 | 503.7400 | 14.423 | -0.001819 |
| 504.6850 | 6.749 | -0.001276 | 504.5290 | 11.835 | 0.002662 | 504.7490 | 14.425 | 0.001970 |
| 505.6910 | 6.751 | -0.001209 | 505.5340 | 11.829 | -0.000078 | 505.7580 | 14.422 | 0.006920 |

Table C-6: TGA and DTG for 1wt%, 3wt%, and 5wt% AO in Cross-Linked PMMA

| 1wt% AO in Cross-Linked PMMA (10C/min) | | | 3wt% AO in Cross-Linked PMMA (10C/min) | | | 5wt% AO in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 100.0110 | 100.000 | -0.004986 | 100.0220 | 100.000 | 0.005016 | 100.1140 | 100.000 | 0.001850 |
| 100.9900 | 100.001 | -0.000047 | 101.0140 | 99.996 | -0.001150 | 101.0990 | 99.992 | 0.007518 |
| 101.9640 | 100.000 | -0.004926 | 101.9880 | 99.996 | -0.000779 | 102.0830 | 99.988 | -0.000788 |
| 102.9460 | 100.001 | -0.000110 | 102.9720 | 99.995 | 0.005016 | 103.0880 | 99.991 | -0.001991 |
| 103.9300 | 99.997 | -0.000016 | 103.9550 | 99.991 | -0.000814 | 104.0680 | 99.985 | 0.010580 |
| 104.9150 | 99.999 | -0.000016 | 104.9410 | 99.990 | -0.001034 | 105.0660 | 99.978 | 0.005649 |
| 105.9140 | 99.997 | 0.005016 | 105.9240 | 99.993 | 0.005016 | 106.0570 | 99.975 | -0.002402 |
| 106.8950 | 99.997 | -0.000345 | 106.9080 | 99.988 | 0.005016 | 107.0600 | 99.974 | 0.004379 |
| 107.8780 | 99.994 | -0.000016 | 107.8940 | 99.986 | -0.000710 | 108.0370 | 99.970 | 0.005016 |
| 108.8660 | 99.993 | -0.000175 | 108.8890 | 99.986 | 0.005016 | 109.0330 | 99.960 | 0.009991 |
| 109.8610 | 99.992 | 0.005016 | 109.8850 | 99.979 | 0.005016 | 110.0240 | 99.953 | 0.000070 |
| 110.8470 | 99.990 | 0.000075 | 110.8660 | 99.972 | 0.005016 | 111.0190 | 99.952 | 0.005649 |
| 111.8450 | 99.987 | 0.005016 | 111.8580 | 99.970 | -0.005497 | 112.0260 | 99.947 | -0.005814 |
| 112.8300 | 99.984 | 0.000015 | 112.8560 | 99.967 | 0.011143 | 113.0160 | 99.945 | 0.012023 |
| 113.8260 | 99.985 | 0.005016 | 113.8560 | 99.959 | -0.000744 | 114.0100 | 99.932 | 0.002543 |
| 114.8180 | 99.977 | 0.005016 | 114.8460 | 99.958 | 0.005016 | 115.0180 | 99.927 | 0.005016 |
| 115.8050 | 99.977 | -0.004148 | 115.8420 | 99.954 | 0.005016 | 116.0080 | 99.922 | 0.010547 |
| 116.8090 | 99.974 | 0.005016 | 116.8300 | 99.945 | 0.005016 | 117.0040 | 99.912 | 0.009685 |
| 117.8090 | 99.971 | 0.000163 | 117.8350 | 99.940 | -0.000544 | 118.0130 | 99.904 | 0.007418 |
| 118.8160 | 99.965 | 0.010048 | 118.8360 | 99.934 | 0.005016 | 119.0190 | 99.892 | 0.013452 |
| 119.8230 | 99.961 | -0.000078 | 119.8190 | 99.926 | 0.010390 | 120.0190 | 99.882 | 0.007549 |
| 120.8180 | 99.959 | 0.005016 | 120.8430 | 99.920 | 0.005016 | 121.0300 | 99.877 | 0.005673 |
| 121.8240 | 99.952 | 0.010672 | 121.8440 | 99.916 | 0.011066 | 122.0310 | 99.867 | 0.011776 |
| 122.8150 | 99.945 | 0.000191 | 122.8300 | 99.906 | 0.016400 | 123.0420 | 99.857 | 0.008770 |
| 123.8290 | 99.938 | 0.005016 | 123.8450 | 99.896 | -0.000959 | 124.0540 | 99.845 | 0.010952 |
| 124.8370 | 99.930 | 0.005016 | 124.8490 | 99.891 | 0.016267 | 125.0830 | 99.836 | 0.006893 |
| 125.8280 | 99.922 | 0.005016 | 125.8660 | 99.877 | 0.005016 | 126.1020 | 99.821 | 0.018457 |
| 126.8500 | 99.917 | -0.004412 | 126.8790 | 99.864 | 0.010742 | 127.1190 | 99.806 | 0.009904 |
| 127.8690 | 99.911 | 0.009927 | 127.8930 | 99.855 | 0.005016 | 128.1350 | 99.793 | 0.012139 |
| 128.8860 | 99.902 | 0.005016 | 128.9170 | 99.846 | 0.016819 | 129.1720 | 99.778 | 0.013880 |
| 129.9110 | 99.895 | 0.009927 | 129.9500 | 99.829 | 0.010675 | 130.1980 | 99.764 | 0.014623 |
| 130.9300 | 99.884 | 0.009703 | 130.9860 | 99.821 | 0.010609 | 131.2250 | 99.751 | 0.011310 |
| 131.9560 | 99.878 | 0.005016 | 132.0260 | 99.810 | 0.005016 | 132.2460 | 99.735 | 0.017345 |
| 132.9690 | 99.873 | 0.005016 | 133.0620 | 99.795 | 0.016400 | 133.2640 | 99.722 | 0.006238 |
| 133.9990 | 99.866 | 0.000275 | 134.0890 | 99.778 | 0.010331 | 134.2810 | 99.714 | 0.011737 |
| 135.0300 | 99.862 | 0.009676 | 135.1240 | 99.772 | 0.010420 | 135.2960 | 99.702 | 0.006252 |
| 136.0550 | 99.851 | 0.005016 | 136.1460 | 99.759 | 0.010708 | 136.3190 | 99.693 | 0.011670 |
| 137.0830 | 99.850 | 0.000220 | 137.1630 | 99.751 | -0.000710 | 137.3300 | 99.684 | 0.001646 |
| 138.1160 | 99.842 | 0.010110 | 138.1680 | 99.750 | 0.005016 | 138.3340 | 99.677 | 0.008018 |
| 139.1310 | 99.842 | 0.000163 | 139.1780 | 99.742 | 0.010954 | 139.3450 | 99.666 | 0.008518 |
| 140.1470 | 99.838 | 0.005016 | 140.1850 | 99.731 | 0.010544 | 140.3660 | 99.663 | 0.001850 |
| 141.1720 | 99.835 | 0.000015 | 141.1950 | 99.728 | -0.000744 | 141.3680 | 99.658 | 0.013374 |
| 142.1940 | 99.831 | 0.005016 | 142.1980 | 99.726 | 0.010954 | 142.3790 | 99.646 | 0.009369 |
| 143.1970 | 99.829 | 0.000105 | 143.1910 | 99.716 | 0.005016 | 143.3970 | 99.639 | 0.004367 |
| 144.2120 | 99.825 | 0.005016 | 144.2220 | 99.712 | -0.000710 | 144.3980 | 99.634 | 0.005016 |
| 145.2210 | 99.823 | 0.000015 | 145.2310 | 99.714 | -0.000922 | 145.4130 | 99.629 | 0.005016 |
| 146.2280 | 99.824 | 0.005016 | 146.2320 | 99.708 | -0.000744 | 146.4330 | 99.624 | 0.005016 |
| 147.2410 | 99.821 | 0.005016 | 147.2430 | 99.708 | -0.000779 | 147.4480 | 99.621 | 0.005016 |
| 148.2640 | 99.820 | -0.005567 | 148.2450 | 99.706 | 0.005016 | 148.4500 | 99.615 | 0.008089 |
| 149.2660 | 99.821 | 0.000045 | 149.2590 | 99.699 | 0.016468 | 149.4650 | 99.611 | 0.004412 |
| 150.2790 | 99.817 | -0.004633 | 150.2840 | 99.690 | -0.001034 | 150.4800 | 99.607 | 0.008125 |
| 151.2770 | 99.820 | 0.000163 | 151.2920 | 99.693 | 0.005016 | 151.4900 | 99.599 | 0.007489 |
| 152.2940 | 99.818 | 0.000356 | 152.3050 | 99.690 | 0.005016 | 152.5160 | 99.593 | 0.005016 |
| 153.3070 | 99.819 | -0.004521 | 153.3220 | 99.682 | 0.005016 | 153.5300 | 99.589 | 0.005016 |
| 154.3250 | 99.818 | 0.005016 | 154.3300 | 99.684 | -0.005613 | 154.5420 | 99.584 | 0.006252 |
| 155.3420 | 99.818 | -0.004807 | 155.3640 | 99.686 | 0.010954 | 155.5540 | 99.578 | 0.005016 |
| 156.3540 | 99.817 | 0.009927 | 156.3730 | 99.676 | -0.000850 | 156.5770 | 99.576 | 0.004409 |
| 157.3790 | 99.812 | -0.004807 | 157.3910 | 99.674 | -0.000643 | 157.5970 | 99.571 | -0.000208 |
| 158.3950 | 99.814 | 0.005016 | 158.4120 | 99.675 | -0.000643 | 158.6090 | 99.567 | 0.007503 |
| 159.4020 | 99.808 | 0.000356 | 159.4230 | 99.669 | 0.010641 | 159.6360 | 99.565 | 0.000529 |
| 160.4200 | 99.809 | -0.004358 | 160.4450 | 99.665 | -0.001072 | 160.6490 | 99.558 | 0.005016 |
| 161.4340 | 99.808 | 0.009785 | 161.4510 | 99.669 | -0.000744 | 161.6660 | 99.556 | 0.001791 |
| 162.4620 | 99.802 | 0.000163 | 162.4730 | 99.666 | 0.010420 | 162.6840 | 99.553 | 0.005016 |
| 163.4770 | 99.805 | 0.000015 | 163.4940 | 99.659 | -0.000744 | 163.6900 | 99.546 | 0.010853 |
| 164.4980 | 99.801 | 0.000302 | 164.5080 | 99.661 | -0.000358 | 164.7130 | 99.537 | -0.002745 |
| 165.5180 | 99.805 | -0.000078 | 165.5400 | 99.660 | -0.000744 | 165.7380 | 99.535 | 0.002528 |

Table C-6: Continued

| 1wt% AO in Cross-Linked PMMA (10C/min) | | | 3wt% AO in Cross-Linked PMMA (10C/min) | | | 5wt% AO in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 166.5380 | 99.803 | 0.005016 | 166.5540 | 99.659 | 0.005016 | 166.7500 | 99.532 | 0.005016 |
| 167.5560 | 99.804 | 0.000220 | 167.5740 | 99.657 | -0.000577 | 167.7780 | 99.525 | 0.007474 |
| 168.5780 | 99.801 | -0.000047 | 168.5990 | 99.659 | 0.005016 | 168.7910 | 99.520 | -0.000357 |
| 169.6010 | 99.800 | -0.004521 | 169.6180 | 99.650 | 0.010482 | 169.8190 | 99.514 | 0.010613 |
| 170.6130 | 99.800 | 0.005016 | 170.6400 | 99.649 | -0.006105 | 170.8330 | 99.506 | 0.000011 |
| 171.6340 | 99.799 | 0.000220 | 171.6570 | 99.648 | 0.005016 | 171.8580 | 99.504 | 0.002483 |
| 172.6570 | 99.798 | 0.005016 | 172.6850 | 99.649 | 0.010609 | 172.8760 | 99.501 | 0.003772 |
| 173.6830 | 99.797 | 0.000163 | 173.7030 | 99.643 | 0.005016 | 173.9040 | 99.495 | 0.008682 |
| 174.6970 | 99.794 | 0.000606 | 174.7230 | 99.646 | -0.000513 | 174.9280 | 99.489 | 0.003742 |
| 175.7240 | 99.792 | -0.004521 | 175.7460 | 99.644 | 0.005016 | 175.9440 | 99.486 | 0.004412 |
| 176.7500 | 99.791 | 0.005016 | 176.7650 | 99.638 | 0.010641 | 176.9750 | 99.481 | 0.004416 |
| 177.7670 | 99.792 | 0.005016 | 177.7930 | 99.637 | -0.000886 | 177.9970 | 99.476 | 0.005016 |
| 178.8020 | 99.785 | 0.000015 | 178.8100 | 99.638 | -0.000513 | 179.0090 | 99.470 | 0.009343 |
| 179.8190 | 99.787 | 0.000045 | 179.8370 | 99.633 | -0.000710 | 180.0370 | 99.464 | 0.003204 |
| 180.8380 | 99.784 | 0.005016 | 180.8600 | 99.634 | -0.000779 | 181.0570 | 99.463 | 0.005016 |
| 181.8710 | 99.780 | -0.005636 | 181.8770 | 99.637 | -0.000544 | 182.0880 | 99.458 | 0.005623 |
| 182.8880 | 99.782 | 0.005016 | 182.9090 | 99.630 | 0.005016 | 183.1060 | 99.450 | 0.006828 |
| 183.9010 | 99.775 | -0.003997 | 183.9290 | 99.627 | -0.000710 | 184.1210 | 99.445 | 0.003235 |
| 184.9310 | 99.777 | 0.000382 | 184.9520 | 99.627 | -0.000610 | 185.1570 | 99.442 | 0.000041 |
| 185.9570 | 99.774 | 0.000302 | 185.9740 | 99.623 | 0.005016 | 186.1810 | 99.436 | 0.007518 |
| 186.9850 | 99.773 | 0.005016 | 186.9970 | 99.620 | -0.000610 | 187.1930 | 99.430 | 0.005623 |
| 188.0060 | 99.770 | 0.005016 | 188.0220 | 99.621 | -0.000676 | 188.2280 | 99.425 | 0.005016 |
| 189.0300 | 99.766 | 0.000163 | 189.0460 | 99.619 | -0.000814 | 189.2500 | 99.422 | 0.000070 |
| 190.0490 | 99.765 | 0.000302 | 190.0710 | 99.613 | 0.010708 | 190.2740 | 99.420 | 0.002354 |
| 191.0770 | 99.762 | 0.005016 | 191.0960 | 99.611 | -0.006368 | 191.2930 | 99.415 | 0.005016 |
| 192.1040 | 99.761 | -0.004577 | 192.1220 | 99.612 | 0.016819 | 192.3260 | 99.407 | 0.009395 |
| 193.1170 | 99.761 | 0.005016 | 193.1380 | 99.603 | 0.005016 | 193.3480 | 99.399 | 0.002543 |
| 194.1420 | 99.757 | 0.005016 | 194.1680 | 99.604 | -0.006644 | 194.3720 | 99.400 | -0.002536 |
| 195.1670 | 99.756 | 0.005016 | 195.1830 | 99.603 | -0.000513 | 195.3910 | 99.397 | 0.005016 |
| 196.1920 | 99.753 | 0.005016 | 196.2070 | 99.599 | 0.005016 | 196.4170 | 99.392 | -0.000080 |
| 197.2120 | 99.749 | 0.000630 | 197.2370 | 99.591 | 0.005016 | 197.4320 | 99.389 | 0.004412 |
| 198.2360 | 99.747 | 0.000653 | 198.2530 | 99.593 | -0.005978 | 198.4610 | 99.380 | 0.011020 |
| 199.2640 | 99.747 | 0.005016 | 199.2740 | 99.587 | 0.005016 | 199.4820 | 99.376 | 0.001393 |
| 200.2930 | 99.742 | 0.000356 | 200.3020 | 99.585 | -0.000676 | 200.5070 | 99.371 | 0.008619 |
| 201.3230 | 99.740 | 0.000302 | 201.3270 | 99.580 | 0.005016 | 201.5340 | 99.366 | 0.001350 |
| 202.3470 | 99.738 | 0.005016 | 202.3570 | 99.580 | -0.000544 | 202.5630 | 99.363 | 0.006260 |
| 203.3770 | 99.733 | 0.005016 | 203.3840 | 99.571 | 0.010513 | 203.5870 | 99.355 | 0.005016 |
| 204.4000 | 99.729 | 0.005016 | 204.4120 | 99.569 | -0.000744 | 204.6170 | 99.349 | 0.003204 |
| 205.4290 | 99.725 | 0.000247 | 205.4350 | 99.568 | 0.005016 | 205.6390 | 99.346 | 0.002655 |
| 206.4500 | 99.724 | 0.000220 | 206.4660 | 99.565 | 0.005016 | 206.6770 | 99.341 | 0.011505 |
| 207.4820 | 99.721 | 0.005016 | 207.4960 | 99.561 | -0.000544 | 207.6990 | 99.333 | 0.007446 |
| 208.5140 | 99.719 | 0.005016 | 208.5310 | 99.558 | 0.005016 | 208.7250 | 99.329 | 0.002114 |
| 209.5450 | 99.715 | 0.000220 | 209.5540 | 99.552 | 0.005016 | 209.7670 | 99.327 | 0.004375 |
| 210.5790 | 99.711 | 0.005016 | 210.5830 | 99.546 | 0.005016 | 210.7810 | 99.322 | 0.005016 |
| 211.6090 | 99.710 | 0.000105 | 211.6130 | 99.544 | -0.000610 | 211.8080 | 99.316 | 0.007984 |
| 212.6310 | 99.705 | 0.005016 | 212.6400 | 99.543 | 0.010513 | 212.8400 | 99.310 | 0.007351 |
| 213.6720 | 99.704 | 0.000220 | 213.6650 | 99.533 | -0.000419 | 213.8750 | 99.305 | 0.003794 |
| 214.7000 | 99.701 | 0.005016 | 214.7070 | 99.528 | -0.000481 | 214.9140 | 99.301 | 0.004379 |
| 215.7280 | 99.697 | 0.005016 | 215.7400 | 99.526 | -0.000710 | 215.9350 | 99.295 | 0.010328 |
| 216.7590 | 99.692 | 0.009898 | 216.7610 | 99.518 | 0.010513 | 216.9720 | 99.287 | 0.003780 |
| 217.7820 | 99.686 | 0.005016 | 217.7920 | 99.511 | -0.011106 | 218.0070 | 99.284 | 0.013452 |
| 218.8210 | 99.682 | 0.005016 | 218.8260 | 99.514 | 0.005016 | 219.0310 | 99.272 | 0.009219 |
| 219.8550 | 99.678 | 0.005016 | 219.8530 | 99.509 | 0.010544 | 220.0570 | 99.265 | 0.004401 |
| 220.8890 | 99.673 | 0.005016 | 220.8910 | 99.500 | 0.010576 | 221.0900 | 99.258 | 0.011020 |
| 221.9090 | 99.671 | 0.000220 | 221.9220 | 99.491 | -0.012265 | 222.1200 | 99.246 | 0.006882 |
| 222.9380 | 99.667 | 0.009927 | 222.9470 | 99.492 | 0.005016 | 223.1450 | 99.239 | 0.006210 |
| 223.9780 | 99.660 | 0.005016 | 223.9800 | 99.481 | -0.000577 | 224.1840 | 99.232 | 0.006275 |
| 225.0060 | 99.656 | 0.009812 | 225.0160 | 99.477 | 0.005016 | 225.2090 | 99.228 | 0.003801 |
| 226.0350 | 99.648 | 0.000105 | 226.0430 | 99.475 | -0.000676 | 226.2410 | 99.222 | 0.012867 |
| 227.0670 | 99.646 | 0.005016 | 227.0630 | 99.469 | 0.015529 | 227.2760 | 99.211 | 0.009195 |
| 228.0860 | 99.641 | 0.005016 | 228.0960 | 99.457 | -0.012265 | 228.2980 | 99.203 | 0.006224 |
| 229.1270 | 99.637 | 0.005016 | 229.1220 | 99.456 | 0.005016 | 229.3280 | 99.195 | 0.010580 |
| 230.1480 | 99.632 | 0.005016 | 230.1570 | 99.451 | 0.005016 | 230.3650 | 99.186 | 0.009395 |
| 231.1820 | 99.623 | 0.009785 | 231.1790 | 99.441 | 0.005016 | 231.3910 | 99.177 | 0.006245 |
| 232.2130 | 99.616 | 0.005016 | 232.2120 | 99.439 | 0.005016 | 232.4240 | 99.171 | 0.010749 |
| 233.2430 | 99.608 | 0.005016 | 233.2420 | 99.427 | 0.010609 | 233.4530 | 99.158 | 0.009268 |

Table C-6: Continued

| 1wt% AO in Cross-Linked PMMA (10C/min) | | | 3wt% AO in Cross-Linked PMMA (10C/min) | | | 5wt% AO in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 234.2840 | 99.603 | 0.005016 | 234.2800 | 99.421 | 0.005016 | 234.4760 | 99.150 | 0.012434 |
| 235.2960 | 99.598 | 0.005016 | 235.3000 | 99.414 | -0.000419 | 235.5080 | 99.139 | 0.008747 |
| 236.3270 | 99.593 | 0.009547 | 236.3280 | 99.412 | 0.005016 | 236.5340 | 99.131 | 0.007364 |
| 237.3700 | 99.582 | 0.005016 | 237.3540 | 99.397 | 0.015886 | 237.5640 | 99.122 | 0.012434 |
| 238.3870 | 99.579 | 0.009898 | 238.3870 | 99.390 | 0.010544 | 238.5890 | 99.108 | 0.011939 |
| 239.4210 | 99.567 | 0.009812 | 239.4150 | 99.380 | 0.005016 | 239.6180 | 99.100 | 0.011697 |
| 240.4500 | 99.563 | 0.005016 | 240.4500 | 99.378 | 0.005016 | 240.6490 | 99.083 | 0.012348 |
| 241.4870 | 99.554 | 0.010110 | 241.4810 | 99.364 | -0.000643 | 241.6780 | 99.074 | 0.006849 |
| 242.5140 | 99.545 | 0.005016 | 242.5010 | 99.362 | 0.010846 | 242.7100 | 99.066 | 0.012305 |
| 243.5290 | 99.540 | 0.009841 | 243.5340 | 99.350 | -0.000643 | 243.7370 | 99.050 | 0.017922 |
| 244.5640 | 99.532 | 0.009812 | 244.5600 | 99.339 | 0.010513 | 244.7660 | 99.039 | 0.008053 |
| 245.5960 | 99.523 | 0.005016 | 245.5910 | 99.329 | -0.005915 | 245.7960 | 99.028 | 0.017194 |
| 246.6150 | 99.515 | 0.009624 | 246.6240 | 99.326 | 0.005016 | 246.8170 | 99.017 | 0.007377 |
| 247.6600 | 99.504 | 0.009957 | 247.6370 | 99.315 | 0.010420 | 247.8490 | 99.004 | 0.023345 |
| 248.6820 | 99.497 | 0.005016 | 248.6690 | 99.304 | 0.015704 | 248.8820 | 98.986 | 0.017603 |
| 249.7220 | 99.487 | 0.009957 | 249.7050 | 99.296 | -0.000577 | 249.9100 | 98.970 | 0.013471 |
| 250.7400 | 99.477 | 0.009869 | 250.7310 | 99.286 | 0.010708 | 250.9340 | 98.955 | 0.016168 |
| 251.7730 | 99.465 | 0.010110 | 251.7570 | 99.276 | 0.005016 | 251.9580 | 98.941 | 0.013422 |
| 252.7990 | 99.454 | 0.009676 | 252.7860 | 99.266 | 0.010641 | 252.9930 | 98.927 | 0.016013 |
| 253.8350 | 99.439 | 0.014898 | 253.8100 | 99.258 | 0.010544 | 254.0220 | 98.910 | 0.017846 |
| 254.8530 | 99.430 | 0.014839 | 254.8420 | 99.242 | 0.010675 | 255.0480 | 98.893 | 0.015463 |
| 255.8920 | 99.415 | 0.014958 | 255.8740 | 99.230 | 0.010776 | 256.0680 | 98.877 | 0.017205 |
| 256.9230 | 99.404 | 0.010558 | 256.9010 | 99.223 | 0.010609 | 257.0910 | 98.859 | 0.015762 |
| 257.9440 | 99.392 | 0.009927 | 257.9270 | 99.208 | 0.010609 | 258.1280 | 98.843 | 0.018379 |
| 258.9690 | 99.378 | 0.019839 | 258.9490 | 99.195 | 0.010641 | 259.1560 | 98.823 | 0.016013 |
| 259.9920 | 99.362 | 0.014079 | 259.9840 | 99.184 | 0.010708 | 260.1820 | 98.806 | 0.019594 |
| 261.0250 | 99.351 | 0.019662 | 261.0020 | 99.172 | 0.010576 | 261.2130 | 98.786 | 0.019579 |
| 262.0550 | 99.335 | 0.014722 | 262.0310 | 99.159 | 0.016468 | 262.2300 | 98.762 | 0.021358 |
| 263.0820 | 99.321 | 0.014780 | 263.0630 | 99.144 | 0.010708 | 263.2580 | 98.741 | 0.021228 |
| 264.1010 | 99.305 | 0.014232 | 264.0930 | 99.135 | 0.016267 | 264.3000 | 98.717 | 0.027217 |
| 265.1330 | 99.292 | 0.014336 | 265.1070 | 99.118 | 0.016400 | 265.3150 | 98.695 | 0.020450 |
| 266.1520 | 99.273 | 0.018610 | 266.1320 | 99.100 | 0.015645 | 266.3450 | 98.672 | 0.021925 |
| 267.1860 | 99.256 | 0.014898 | 267.1600 | 99.087 | 0.015764 | 267.3710 | 98.648 | 0.024885 |
| 268.2150 | 99.238 | 0.018996 | 268.1880 | 99.074 | 0.010576 | 268.3990 | 98.624 | 0.024409 |
| 269.2350 | 99.222 | 0.014284 | 269.2180 | 99.057 | 0.016073 | 269.4230 | 98.595 | 0.030984 |
| 270.2680 | 99.202 | 0.014665 | 270.2450 | 99.046 | 0.010708 | 270.4460 | 98.570 | 0.023784 |
| 271.2930 | 99.186 | 0.014839 | 271.2680 | 99.029 | 0.016400 | 271.4690 | 98.543 | 0.031588 |
| 272.3240 | 99.168 | 0.019576 | 272.2960 | 99.011 | 0.028057 | 272.4980 | 98.514 | 0.028586 |
| 273.3450 | 99.145 | 0.019239 | 273.3150 | 98.990 | 0.005016 | 273.5320 | 98.486 | 0.025911 |
| 274.3650 | 99.126 | 0.024090 | 274.3420 | 98.980 | 0.010742 | 274.5530 | 98.456 | 0.035971 |
| 275.3990 | 99.103 | 0.024202 | 275.3670 | 98.966 | 0.021138 | 275.5750 | 98.424 | 0.025401 |
| 276.4170 | 99.079 | 0.024090 | 276.3930 | 98.944 | 0.016468 | 276.5960 | 98.390 | 0.033793 |
| 277.4440 | 99.056 | 0.024661 | 277.4170 | 98.930 | 0.010882 | 277.6190 | 98.359 | 0.028163 |
| 278.4660 | 99.025 | 0.028317 | 278.4380 | 98.913 | 0.021320 | 278.6410 | 98.327 | 0.033509 |
| 279.5050 | 98.997 | 0.029870 | 279.4650 | 98.889 | 0.021507 | 279.6720 | 98.291 | 0.034500 |
| 280.5230 | 98.965 | 0.028859 | 280.4940 | 98.871 | 0.016201 | 280.6950 | 98.257 | 0.037254 |
| 281.5450 | 98.936 | 0.027926 | 281.5170 | 98.858 | 0.021601 | 281.7210 | 98.212 | 0.052278 |
| 282.5770 | 98.902 | 0.034661 | 282.5440 | 98.831 | 0.021794 | 282.7410 | 98.164 | 0.046927 |
| 283.5990 | 98.869 | 0.033964 | 283.5650 | 98.813 | 0.016267 | 283.7650 | 98.116 | 0.048394 |
| 284.6300 | 98.834 | 0.030175 | 284.5890 | 98.795 | 0.016606 | 284.7990 | 98.068 | 0.042504 |
| 285.6450 | 98.800 | 0.032663 | 285.6130 | 98.773 | 0.027258 | 285.8220 | 98.022 | 0.049879 |
| 286.6730 | 98.762 | 0.042726 | 286.6380 | 98.749 | 0.021794 | 286.8420 | 97.974 | 0.043507 |
| 287.6950 | 98.722 | 0.033462 | 287.6670 | 98.731 | 0.010882 | 287.8730 | 97.928 | 0.048394 |
| 288.7220 | 98.685 | 0.044307 | 288.6870 | 98.711 | 0.026512 | 288.8890 | 97.877 | 0.050227 |
| 289.7450 | 98.644 | 0.038203 | 289.7060 | 98.684 | 0.021892 | 289.9090 | 97.827 | 0.049701 |
| 290.7730 | 98.604 | 0.039395 | 290.7330 | 98.663 | 0.022092 | 290.9350 | 97.776 | 0.051179 |
| 291.7860 | 98.563 | 0.041878 | 291.7540 | 98.646 | 0.021892 | 291.9540 | 97.726 | 0.047046 |
| 292.8120 | 98.519 | 0.038203 | 292.7810 | 98.619 | 0.021992 | 292.9820 | 97.675 | 0.054106 |
| 293.8330 | 98.479 | 0.038396 | 293.8040 | 98.600 | 0.021992 | 294.0040 | 97.622 | 0.051179 |
| 294.8680 | 98.436 | 0.044073 | 294.8250 | 98.579 | 0.022721 | 295.0250 | 97.568 | 0.057566 |
| 295.8880 | 98.393 | 0.038396 | 295.8470 | 98.551 | 0.027130 | 296.0430 | 97.510 | 0.056052 |
| 296.9100 | 98.349 | 0.047440 | 296.8690 | 98.527 | 0.016267 | 297.0680 | 97.452 | 0.052826 |
| 297.9290 | 98.301 | 0.042510 | 297.8880 | 98.507 | 0.022194 | 298.0940 | 97.394 | 0.058159 |
| 298.9560 | 98.255 | 0.047685 | 298.9160 | 98.481 | 0.027130 | 299.1140 | 97.334 | 0.052671 |
| 299.9790 | 98.205 | 0.048695 | 299.9380 | 98.456 | 0.027920 | 300.1340 | 97.275 | 0.060694 |

Table C-6: Continued

| 1wt% AO in Cross-Linked PMMA (10C/min) | | | 3wt% AO in Cross-Linked PMMA (10C/min) | | | 5wt% AO in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 300.9980 | 98.155 | 0.054129 | 300.9650 | 98.431 | 0.016267 | 301.1570 | 97.212 | 0.060815 |
| 302.0270 | 98.106 | 0.044543 | 301.9820 | 98.405 | 0.034344 | 302.1730 | 97.148 | 0.059940 |
| 303.0480 | 98.057 | 0.047933 | 303.0000 | 98.375 | 0.010811 | 303.1960 | 97.085 | 0.068861 |
| 304.0680 | 98.006 | 0.047685 | 304.0240 | 98.351 | 0.027650 | 304.2180 | 97.017 | 0.063314 |
| 305.0990 | 97.954 | 0.054129 | 305.0410 | 98.324 | 0.021794 | 305.2420 | 96.948 | 0.071831 |
| 306.1150 | 97.901 | 0.057470 | 306.0700 | 98.295 | 0.028057 | 306.2620 | 96.879 | 0.065059 |
| 307.1410 | 97.843 | 0.053548 | 307.0870 | 98.270 | 0.021794 | 307.2760 | 96.808 | 0.070166 |
| 308.1600 | 97.790 | 0.054724 | 308.1100 | 98.242 | 0.028196 | 308.3210 | 96.735 | 0.075789 |
| 309.1770 | 97.733 | 0.051094 | 309.1270 | 98.211 | 0.031886 | 309.3250 | 96.661 | 0.071146 |
| 310.2030 | 97.677 | 0.054425 | 310.1550 | 98.179 | 0.027784 | 310.3550 | 96.585 | 0.075708 |
| 311.2210 | 97.620 | 0.063952 | 311.1680 | 98.157 | 0.031737 | 311.3720 | 96.507 | 0.076919 |
| 312.2360 | 97.560 | 0.047933 | 312.1940 | 98.119 | 0.033476 | 312.3870 | 96.424 | 0.084616 |
| 313.2630 | 97.502 | 0.068108 | 313.2150 | 98.088 | 0.033143 | 313.4050 | 96.341 | 0.079641 |
| 314.2790 | 97.437 | 0.053837 | 314.2390 | 98.054 | 0.027920 | 314.4300 | 96.251 | 0.089308 |
| 315.3030 | 97.377 | 0.070430 | 315.2640 | 98.023 | 0.035651 | 315.4450 | 96.160 | 0.090723 |
| 316.3130 | 97.312 | 0.051884 | 316.2810 | 97.987 | 0.033646 | 316.4680 | 96.071 | 0.089562 |
| 317.3430 | 97.250 | 0.067007 | 317.3010 | 97.954 | 0.032500 | 317.4850 | 95.975 | 0.084908 |
| 318.3600 | 97.178 | 0.070031 | 318.3150 | 97.915 | 0.038967 | 318.5130 | 95.876 | 0.103272 |
| 319.3810 | 97.112 | 0.068483 | 319.3430 | 97.874 | 0.045580 | 319.5290 | 95.772 | 0.101036 |
| 320.3970 | 97.038 | 0.077386 | 320.3540 | 97.832 | 0.038187 | 320.5430 | 95.668 | 0.108261 |
| 321.4100 | 96.961 | 0.068456 | 321.3790 | 97.786 | 0.044626 | 321.5680 | 95.553 | 0.120591 |
| 322.4380 | 96.882 | 0.085525 | 322.4000 | 97.742 | 0.039785 | 322.5830 | 95.437 | 0.114378 |
| 323.4510 | 96.798 | 0.080872 | 323.4150 | 97.694 | 0.051098 | 323.5990 | 95.317 | 0.123966 |
| 324.4700 | 96.712 | 0.080872 | 324.4280 | 97.641 | 0.067628 | 324.6220 | 95.190 | 0.136576 |
| 325.4900 | 96.621 | 0.092893 | 325.4430 | 97.577 | 0.055645 | 325.6310 | 95.055 | 0.136373 |
| 326.5100 | 96.526 | 0.096684 | 326.4620 | 97.519 | 0.060301 | 326.6490 | 94.915 | 0.134687 |
| 327.5300 | 96.424 | 0.106933 | 327.4840 | 97.449 | 0.074976 | 327.6690 | 94.769 | 0.152764 |
| 328.5460 | 96.318 | 0.112422 | 328.5000 | 97.375 | 0.079453 | 328.6820 | 94.608 | 0.163571 |
| 329.5600 | 96.203 | 0.112200 | 329.5180 | 97.292 | 0.079899 | 329.7010 | 94.440 | 0.178924 |
| 330.5770 | 96.081 | 0.123541 | 330.5320 | 97.207 | 0.097179 | 330.7200 | 94.261 | 0.183852 |
| 331.5960 | 95.951 | 0.135281 | 331.5450 | 97.109 | 0.090905 | 331.7340 | 94.072 | 0.193825 |
| 332.6140 | 95.808 | 0.148302 | 332.5680 | 97.010 | 0.116462 | 332.7510 | 93.872 | 0.212054 |
| 333.6230 | 95.657 | 0.151986 | 333.5760 | 96.892 | 0.127447 | 333.7590 | 93.666 | 0.207891 |
| 334.6430 | 95.496 | 0.167089 | 334.5970 | 96.765 | 0.127447 | 334.7780 | 93.443 | 0.229420 |
| 335.6640 | 95.321 | 0.182218 | 335.6070 | 96.632 | 0.142438 | 335.7940 | 93.205 | 0.242915 |
| 336.6760 | 95.137 | 0.196557 | 336.6320 | 96.484 | 0.174417 | 336.8030 | 92.958 | 0.261849 |
| 337.6930 | 94.935 | 0.212534 | 337.6360 | 96.319 | 0.163387 | 337.8240 | 92.688 | 0.273664 |
| 338.7040 | 94.717 | 0.229592 | 338.6560 | 96.150 | 0.190237 | 338.8420 | 92.407 | 0.286911 |
| 339.7190 | 94.477 | 0.258529 | 339.6620 | 95.964 | 0.198546 | 339.8600 | 92.108 | 0.310208 |
| 340.7200 | 94.215 | 0.257749 | 340.6790 | 95.755 | 0.218784 | 340.8740 | 91.793 | 0.312435 |
| 341.7390 | 93.939 | 0.286360 | 341.6950 | 95.533 | 0.238217 | 341.8760 | 91.453 | 0.336556 |
| 342.7490 | 93.637 | 0.303698 | 342.7030 | 95.288 | 0.259992 | 342.8950 | 91.097 | 0.347692 |
| 343.7630 | 93.318 | 0.338063 | 343.7130 | 95.020 | 0.275746 | 343.9120 | 90.718 | 0.398368 |
| 344.7730 | 92.974 | 0.347566 | 344.7250 | 94.734 | 0.294741 | 344.9210 | 90.312 | 0.402869 |
| 345.7850 | 92.608 | 0.390105 | 345.7310 | 94.418 | 0.314372 | 345.9220 | 89.884 | 0.414788 |
| 346.7900 | 92.214 | 0.402978 | 346.7390 | 94.075 | 0.353152 | 346.9410 | 89.429 | 0.465710 |
| 347.7980 | 91.792 | 0.447035 | 347.7430 | 93.705 | 0.359871 | 347.9460 | 88.949 | 0.488056 |
| 348.8080 | 91.340 | 0.450668 | 348.7590 | 93.297 | 0.414550 | 348.9630 | 88.439 | 0.518682 |
| 349.8160 | 90.857 | 0.516369 | 349.7700 | 92.854 | 0.448866 | 349.9660 | 87.902 | 0.506149 |
| 350.8150 | 90.345 | 0.515251 | 350.7690 | 92.382 | 0.492407 | 350.9790 | 87.333 | 0.600456 |
| 351.8220 | 89.799 | 0.543862 | 351.7730 | 91.870 | 0.541921 | 351.9920 | 86.733 | 0.630588 |
| 352.8310 | 89.218 | 0.592253 | 352.7860 | 91.304 | 0.586198 | 353.0020 | 86.100 | 0.671201 |
| 353.8310 | 88.606 | 0.628753 | 353.7910 | 90.686 | 0.673664 | 354.0040 | 85.432 | 0.692545 |
| 354.8330 | 87.952 | 0.657331 | 354.8020 | 90.022 | 0.688236 | 355.0100 | 84.728 | 0.686474 |
| 355.8400 | 87.264 | 0.698272 | 355.8020 | 89.316 | 0.729918 | 356.0140 | 83.989 | 0.735729 |
| 356.8430 | 86.532 | 0.765556 | 356.7990 | 88.570 | 0.763129 | 357.0290 | 83.215 | 0.800921 |
| 357.8430 | 85.760 | 0.785916 | 357.8040 | 87.772 | 0.844024 | 358.0270 | 82.404 | 0.804394 |
| 358.8450 | 84.946 | 0.887107 | 358.8070 | 86.906 | 0.900104 | 359.0450 | 81.552 | 0.895628 |
| 359.8440 | 84.086 | 0.869145 | 359.8110 | 85.997 | 0.935469 | 360.0560 | 80.662 | 0.928293 |
| 360.8460 | 83.184 | 0.951779 | 360.8050 | 85.026 | 0.996925 | 361.0520 | 79.730 | 0.903733 |
| 361.8410 | 82.235 | 0.979303 | 361.8050 | 83.999 | 1.006202 | 362.0600 | 78.753 | 1.017662 |
| 362.8430 | 81.229 | 1.051127 | 362.8070 | 82.918 | 1.092942 | 363.0590 | 77.736 | 1.020087 |
| 363.8480 | 80.128 | 1.176429 | 363.8000 | 81.787 | 1.100880 | 364.0770 | 76.684 | 1.111932 |
| 364.8410 | 78.950 | 1.226408 | 364.8080 | 80.601 | 1.254957 | 365.0720 | 75.587 | 1.073312 |
| 365.8420 | 77.700 | 1.287675 | 365.8020 | 79.379 | 1.297043 | 366.0770 | 74.454 | 1.134568 |

Table C-6: Continued

| 1wt% AO in Cross-Linked PMMA (10C/min) | | | 3wt% AO in Cross-Linked PMMA (10C/min) | | | 5wt% AO in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 366.8400 | 76.398 | 1.298504 | 366.8040 | 78.103 | 1.279324 | 367.0860 | 73.270 | 1.254791 |
| 367.8420 | 75.063 | 1.414205 | 367.8070 | 76.781 | 1.298063 | 368.0930 | 72.048 | 1.248009 |
| 368.8370 | 73.686 | 1.398848 | 368.8120 | 75.427 | 1.343266 | 369.0860 | 70.787 | 1.211220 |
| 369.8350 | 72.284 | 1.508172 | 369.8110 | 74.035 | 1.409013 | 370.0890 | 69.497 | 1.271464 |
| 370.8270 | 70.859 | 1.463463 | 370.8140 | 72.585 | 1.514231 | 371.1030 | 68.161 | 1.330611 |
| 371.8190 | 69.406 | 1.413562 | 371.8110 | 71.065 | 1.559396 | 372.1110 | 66.793 | 1.413818 |
| 372.8190 | 67.921 | 1.559352 | 372.8130 | 69.523 | 1.559791 | 373.1160 | 65.399 | 1.421435 |
| 373.8170 | 66.384 | 1.546679 | 373.8060 | 67.960 | 1.541316 | 374.1190 | 63.984 | 1.467657 |
| 374.8250 | 64.806 | 1.661604 | 374.8230 | 66.383 | 1.627947 | 375.1310 | 62.528 | 1.478229 |
| 375.8240 | 63.122 | 1.721948 | 375.8180 | 64.770 | 1.650835 | 376.1390 | 61.033 | 1.504790 |
| 376.8210 | 61.419 | 1.663839 | 376.8200 | 63.107 | 1.590057 | 377.1430 | 59.538 | 1.495183 |
| 377.8310 | 59.727 | 1.734963 | 377.8280 | 61.437 | 1.613495 | 378.1440 | 58.035 | 1.479948 |
| 378.8370 | 58.037 | 1.700909 | 378.8360 | 59.773 | 1.757579 | 379.1570 | 56.513 | 1.563320 |
| 379.8420 | 56.365 | 1.700573 | 379.8400 | 58.085 | 1.644256 | 380.1670 | 54.953 | 1.606743 |
| 380.8460 | 54.673 | 1.726915 | 380.8390 | 56.373 | 1.711639 | 381.1810 | 53.372 | 1.572132 |
| 381.8640 | 52.969 | 1.769450 | 381.8560 | 54.646 | 1.701975 | 382.1890 | 51.809 | 1.450540 |
| 382.8660 | 51.280 | 1.686900 | 382.8600 | 52.949 | 1.645934 | 383.2100 | 50.277 | 1.510931 |
| 383.8710 | 49.610 | 1.640543 | 383.8730 | 51.258 | 1.634189 | 384.2200 | 48.750 | 1.504969 |
| 384.8830 | 47.947 | 1.572232 | 384.8830 | 49.571 | 1.651029 | 385.2340 | 47.243 | 1.485799 |
| 385.8940 | 46.291 | 1.602956 | 385.8990 | 47.886 | 1.691645 | 386.2510 | 45.761 | 1.451064 |
| 386.9080 | 44.637 | 1.678404 | 386.9020 | 46.217 | 1.659349 | 387.2690 | 44.290 | 1.456260 |
| 387.9250 | 42.998 | 1.665648 | 387.9180 | 44.561 | 1.599275 | 388.2870 | 42.858 | 1.374724 |
| 388.9350 | 41.398 | 1.497203 | 388.9380 | 42.941 | 1.559605 | 389.3000 | 41.449 | 1.353464 |
| 389.9540 | 39.834 | 1.511576 | 389.9590 | 41.381 | 1.542986 | 390.3310 | 40.075 | 1.348169 |
| 390.9710 | 38.298 | 1.457318 | 390.9740 | 39.864 | 1.462096 | 391.3480 | 38.737 | 1.267715 |
| 391.9960 | 36.788 | 1.500745 | 391.9920 | 38.397 | 1.450268 | 392.3670 | 37.431 | 1.227068 |
| 393.0110 | 35.318 | 1.442559 | 393.0110 | 36.974 | 1.338486 | 393.3850 | 36.164 | 1.218762 |
| 394.0360 | 33.896 | 1.315914 | 394.0310 | 35.596 | 1.283276 | 394.4160 | 34.948 | 1.134533 |
| 395.0580 | 32.520 | 1.329382 | 395.0600 | 34.258 | 1.289142 | 395.4380 | 33.775 | 1.094874 |
| 396.0800 | 31.188 | 1.246269 | 396.0840 | 32.984 | 1.171319 | 396.4660 | 32.648 | 1.101997 |
| 397.1130 | 29.908 | 1.234819 | 397.1090 | 31.758 | 1.168871 | 397.4900 | 31.566 | 1.009164 |
| 398.1390 | 28.670 | 1.167192 | 398.1370 | 30.578 | 1.120547 | 398.5130 | 30.531 | 0.977478 |
| 399.1660 | 27.485 | 1.106414 | 399.1570 | 29.445 | 1.030568 | 399.5470 | 29.538 | 0.941641 |
| 400.1980 | 26.344 | 1.026107 | 400.1900 | 28.361 | 1.018684 | 400.5690 | 28.591 | 0.925775 |
| 401.2200 | 25.262 | 0.960270 | 401.2200 | 27.323 | 0.990738 | 401.6000 | 27.683 | 0.872768 |
| 402.2580 | 24.224 | 0.952477 | 402.2480 | 26.344 | 0.960018 | 402.6270 | 26.819 | 0.830861 |
| 403.2880 | 23.241 | 0.928684 | 403.2730 | 25.401 | 0.887362 | 403.6490 | 26.000 | 0.796394 |
| 404.3170 | 22.304 | 0.914227 | 404.3040 | 24.503 | 0.854838 | 404.6780 | 25.225 | 0.744421 |
| 405.3510 | 21.417 | 0.869944 | 405.3290 | 23.652 | 0.830455 | 405.6980 | 24.496 | 0.685314 |
| 406.3770 | 20.577 | 0.799305 | 406.3590 | 22.839 | 0.783273 | 406.7310 | 23.805 | 0.642249 |
| 407.4070 | 19.783 | 0.751389 | 407.3790 | 22.068 | 0.716752 | 407.7500 | 23.156 | 0.597833 |
| 408.4370 | 19.035 | 0.705993 | 408.4060 | 21.345 | 0.682346 | 408.7810 | 22.544 | 0.577461 |
| 409.4720 | 18.326 | 0.691308 | 409.4420 | 20.658 | 0.683696 | 409.8110 | 21.970 | 0.553506 |
| 410.4960 | 17.657 | 0.626358 | 410.4560 | 20.006 | 0.587109 | 410.8350 | 21.429 | 0.530653 |
| 411.5270 | 17.035 | 0.603360 | 411.4920 | 19.401 | 0.570376 | 411.8520 | 20.924 | 0.472721 |
| 412.5510 | 16.450 | 0.544267 | 412.5100 | 18.828 | 0.548238 | 412.8740 | 20.449 | 0.434256 |
| 413.5850 | 15.905 | 0.533359 | 413.5370 | 18.284 | 0.495339 | 413.9090 | 20.000 | 0.434242 |
| 414.6080 | 15.397 | 0.491272 | 414.5670 | 17.781 | 0.485994 | 414.9200 | 19.579 | 0.382548 |
| 415.6350 | 14.924 | 0.441647 | 415.5870 | 17.307 | 0.450759 | 415.9430 | 19.183 | 0.364147 |
| 416.6560 | 14.486 | 0.401210 | 416.6150 | 16.853 | 0.420718 | 416.9670 | 18.810 | 0.360354 |
| 417.6810 | 14.074 | 0.365900 | 417.6340 | 16.439 | 0.396023 | 417.9850 | 18.460 | 0.330448 |
| 418.7120 | 13.693 | 0.355981 | 418.6530 | 16.045 | 0.363168 | 419.0060 | 18.124 | 0.321512 |
| 419.7340 | 13.336 | 0.317886 | 419.6760 | 15.673 | 0.352452 | 420.0260 | 17.810 | 0.298888 |
| 420.7540 | 13.005 | 0.307491 | 420.7070 | 15.325 | 0.340815 | 421.0440 | 17.508 | 0.283209 |
| 421.7800 | 12.694 | 0.288485 | 421.7200 | 15.002 | 0.328210 | 422.0670 | 17.225 | 0.273311 |
| 422.8000 | 12.404 | 0.280718 | 422.7370 | 14.683 | 0.294721 | 423.0790 | 16.953 | 0.261510 |
| 423.8200 | 12.132 | 0.258838 | 423.7520 | 14.393 | 0.275039 | 424.1000 | 16.697 | 0.255754 |
| 424.8340 | 11.872 | 0.239760 | 424.7740 | 14.120 | 0.255792 | 425.1110 | 16.447 | 0.231478 |
| 425.8540 | 11.630 | 0.241071 | 425.7960 | 13.855 | 0.261731 | 426.1310 | 16.215 | 0.227024 |
| 426.8750 | 11.398 | 0.219230 | 426.8010 | 13.605 | 0.232038 | 427.1470 | 15.987 | 0.219463 |
| 427.8870 | 11.181 | 0.207679 | 427.8200 | 13.367 | 0.228144 | 428.1560 | 15.767 | 0.209612 |
| 428.9010 | 10.972 | 0.195604 | 428.8370 | 13.140 | 0.221597 | 429.1770 | 15.555 | 0.208368 |
| 429.9270 | 10.774 | 0.190158 | 429.8530 | 12.923 | 0.199671 | 430.1900 | 15.351 | 0.197074 |
| 430.9420 | 10.581 | 0.180838 | 430.8650 | 12.721 | 0.198526 | 431.1950 | 15.152 | 0.189061 |
| 431.9650 | 10.397 | 0.185255 | 431.8780 | 12.518 | 0.200253 | 432.2160 | 14.958 | 0.190678 |
| 432.9770 | 10.218 | 0.178877 | 432.8840 | 12.319 | 0.180367 | 433.2250 | 14.772 | 0.180779 |

Table C-6: Continued

| 1wt% AO in Cross-Linked PMMA (10C/min) | | | 3wt% AO in Cross-Linked PMMA (10C/min) | | | 5wt% AO in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 433.9880 | 10.042 | 0.168572 | 433.9020 | 12.138 | 0.174207 | 434.2410 | 14.589 | 0.180406 |
| 435.0080 | 9.875 | 0.164172 | 434.9190 | 11.960 | 0.180126 | 435.2570 | 14.413 | 0.182425 |
| 436.0150 | 9.709 | 0.162219 | 435.9340 | 11.783 | 0.164393 | 436.2660 | 14.244 | 0.158912 |
| 437.0370 | 9.549 | 0.155950 | 436.9460 | 11.619 | 0.154343 | 437.2800 | 14.080 | 0.161422 |
| 438.0460 | 9.392 | 0.154580 | 437.9610 | 11.461 | 0.160189 | 438.2950 | 13.920 | 0.150780 |
| 439.0550 | 9.236 | 0.148429 | 438.9650 | 11.301 | 0.150684 | 439.3030 | 13.766 | 0.150666 |
| 440.0640 | 9.087 | 0.144258 | 439.9810 | 11.151 | 0.130070 | 440.3120 | 13.614 | 0.139512 |
| 441.0710 | 8.938 | 0.139729 | 440.9970 | 11.011 | 0.146904 | 441.3260 | 13.473 | 0.138268 |
| 442.0940 | 8.792 | 0.141226 | 442.0010 | 10.872 | 0.130766 | 442.3330 | 13.335 | 0.132707 |
| 443.0990 | 8.651 | 0.144497 | 443.0100 | 10.743 | 0.119108 | 443.3450 | 13.205 | 0.124240 |
| 444.1110 | 8.507 | 0.144601 | 444.0250 | 10.622 | 0.122588 | 444.3540 | 13.081 | 0.116133 |
| 445.1180 | 8.369 | 0.135479 | 445.0410 | 10.503 | 0.110888 | 445.3650 | 12.966 | 0.106418 |
| 446.1230 | 8.233 | 0.130906 | 446.0500 | 10.397 | 0.092366 | 446.3760 | 12.859 | 0.108216 |
| 447.1330 | 8.101 | 0.127802 | 447.0640 | 10.302 | 0.094215 | 447.3780 | 12.760 | 0.090945 |
| 448.1450 | 7.971 | 0.127550 | 448.0730 | 10.210 | 0.083773 | 448.3910 | 12.667 | 0.088838 |
| 449.1520 | 7.846 | 0.124361 | 449.0820 | 10.131 | 0.072582 | 449.3980 | 12.584 | 0.073256 |
| 450.1680 | 7.720 | 0.125007 | 450.1000 | 10.060 | 0.072294 | 450.4110 | 12.507 | 0.071162 |
| 451.1740 | 7.602 | 0.120450 | 451.1090 | 9.990 | 0.060229 | 451.4100 | 12.440 | 0.060613 |
| 452.1820 | 7.483 | 0.115029 | 452.1170 | 9.935 | 0.045607 | 452.4240 | 12.381 | 0.053853 |
| 453.1960 | 7.375 | 0.105539 | 453.1240 | 9.891 | 0.038998 | 453.4270 | 12.328 | 0.050804 |
| 454.2040 | 7.269 | 0.109040 | 454.1460 | 9.846 | 0.045580 | 454.4340 | 12.281 | 0.044428 |
| 455.2090 | 7.167 | 0.095142 | 455.1580 | 9.809 | 0.033273 | 455.4440 | 12.237 | 0.042373 |
| 456.2290 | 7.073 | 0.091482 | 456.1570 | 9.778 | 0.035332 | 456.4510 | 12.200 | 0.034866 |
| 457.2330 | 6.983 | 0.084594 | 457.1700 | 9.745 | 0.031673 | 457.4580 | 12.165 | 0.031917 |
| 458.2450 | 6.904 | 0.074973 | 458.1830 | 9.716 | 0.021642 | 458.4630 | 12.136 | 0.028789 |
| 459.2540 | 6.827 | 0.074342 | 459.1850 | 9.699 | 0.021923 | 459.4640 | 12.106 | 0.027490 |
| 460.2660 | 6.757 | 0.064577 | 460.1920 | 9.675 | 0.025387 | 460.4750 | 12.077 | 0.022529 |
| 461.2700 | 6.694 | 0.061160 | 461.2030 | 9.651 | 0.017259 | 461.4820 | 12.054 | 0.029080 |
| 462.2840 | 6.638 | 0.051527 | 462.2090 | 9.637 | 0.017765 | 462.4870 | 12.028 | 0.022853 |
| 463.3010 | 6.587 | 0.050806 | 463.2150 | 9.614 | 0.019903 | 463.4920 | 12.006 | 0.025911 |
| 464.3070 | 6.540 | 0.041900 | 464.2220 | 9.599 | 0.013868 | 464.5020 | 11.985 | 0.019117 |
| 465.3180 | 6.499 | 0.037047 | 465.2340 | 9.587 | 0.016819 | 465.5050 | 11.968 | 0.014791 |
| 466.3370 | 6.463 | 0.032356 | 466.2400 | 9.568 | 0.019246 | 466.5070 | 11.952 | 0.016762 |
| 467.3440 | 6.433 | 0.029282 | 467.2530 | 9.554 | 0.012463 | 467.5160 | 11.936 | 0.014630 |
| 468.3510 | 6.406 | 0.023679 | 468.2470 | 9.542 | 0.012504 | 468.5210 | 11.918 | 0.015651 |
| 469.3500 | 6.382 | 0.022259 | 469.2580 | 9.529 | 0.016468 | 469.5240 | 11.902 | 0.017528 |
| 470.3670 | 6.360 | 0.023791 | 470.2650 | 9.515 | 0.010811 | 470.5320 | 11.885 | 0.013400 |
| 471.3710 | 6.337 | 0.016950 | 471.2650 | 9.505 | 0.010742 | 471.5340 | 11.871 | 0.013247 |
| 472.3800 | 6.323 | 0.017392 | 472.2710 | 9.493 | 0.013656 | 472.5390 | 11.855 | 0.013827 |
| 473.3890 | 6.307 | 0.012301 | 473.2880 | 9.482 | 0.004422 | 473.5500 | 11.843 | 0.013520 |
| 474.3980 | 6.295 | 0.013019 | 474.2900 | 9.473 | 0.010675 | 474.5530 | 11.828 | 0.016277 |
| 475.4010 | 6.283 | 0.015402 | 475.2910 | 9.464 | 0.012287 | 475.5630 | 11.814 | 0.010207 |
| 476.4080 | 6.269 | 0.007339 | 476.3050 | 9.449 | 0.013228 | 476.5620 | 11.805 | 0.014849 |
| 477.4150 | 6.260 | 0.011380 | 477.3090 | 9.439 | 0.005592 | 477.5700 | 11.788 | 0.009268 |
| 478.4220 | 6.248 | 0.008393 | 478.3190 | 9.433 | 0.006189 | 478.5780 | 11.779 | 0.008792 |
| 479.4330 | 6.241 | 0.009800 | 479.3210 | 9.424 | 0.013656 | 479.5790 | 11.767 | 0.013005 |
| 480.4380 | 6.230 | 0.008689 | 480.3280 | 9.416 | 0.006765 | 480.5870 | 11.757 | 0.006275 |
| 481.4400 | 6.224 | 0.010468 | 481.3420 | 9.406 | 0.015574 | 481.5970 | 11.749 | 0.012110 |
| 482.4420 | 6.212 | 0.010184 | 482.3390 | 9.395 | 0.008452 | 482.5990 | 11.738 | 0.005016 |
| 483.4540 | 6.205 | 0.005354 | 483.3490 | 9.391 | -0.007227 | 483.6020 | 11.732 | 0.006322 |
| 484.4590 | 6.197 | 0.010218 | 484.3510 | 9.391 | 0.015447 | 484.6020 | 11.726 | 0.005616 |
| 485.4700 | 6.189 | 0.000964 | 485.3620 | 9.376 | 0.010846 | 485.6060 | 11.719 | 0.005631 |
| 486.4800 | 6.185 | 0.007253 | 486.3620 | 9.367 | 0.006694 | 486.6140 | 11.712 | 0.003128 |
| 487.4790 | 6.175 | 0.007914 | 487.3670 | 9.366 | 0.003338 | 487.6210 | 11.706 | 0.009395 |
| 488.4800 | 6.169 | 0.008221 | 488.3750 | 9.357 | 0.009490 | 488.6230 | 11.696 | -0.000548 |
| 489.4930 | 6.161 | 0.008767 | 489.3830 | 9.353 | 0.002083 | 489.6350 | 11.692 | 0.006275 |
| 490.4980 | 6.153 | 0.006216 | 490.3860 | 9.348 | 0.009048 | 490.6350 | 11.683 | 0.008885 |
| 491.5060 | 6.148 | 0.005066 | 491.3910 | 9.339 | 0.010231 | 491.6380 | 11.678 | 0.002514 |
| 492.5140 | 6.141 | 0.007345 | 492.3950 | 9.333 | 0.001055 | 492.6420 | 11.675 | 0.005634 |
| 493.5120 | 6.137 | 0.002584 | 493.3940 | 9.333 | 0.004453 | 493.6480 | 11.670 | 0.005669 |
| 494.5240 | 6.132 | 0.006969 | 494.4050 | 9.325 | 0.007862 | 494.6550 | 11.662 | 0.011310 |
| 495.5240 | 6.127 | 0.002931 | 495.4120 | 9.319 | 0.005603 | 495.6540 | 11.653 | 0.003139 |
| 496.5380 | 6.121 | 0.004714 | 496.4160 | 9.314 | 0.005016 | 496.6630 | 11.649 | 0.008770 |
| 497.5410 | 6.119 | 0.002965 | 497.4220 | 9.310 | 0.005016 | 497.6720 | 11.641 | 0.005016 |
| 498.5410 | 6.113 | 0.006244 | 498.4250 | 9.304 | 0.002187 | 498.6730 | 11.640 | -0.000614 |
| 499.5440 | 6.107 | 0.006167 | 499.4280 | 9.304 | 0.006135 | 499.6830 | 11.639 | 0.003757 |

Table C-6: Continued

| 1wt% AO in Cross-Linked PMMA (10C/min) | | | 3wt% AO in Cross-Linked PMMA (10C/min) | | | 5wt% AO in Cross-Linked PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 500.5600 | 6.102 | 0.004181 | 500.4440 | 9.295 | 0.006694 | 500.6890 | 11.635 | 0.005016 |
| 501.5680 | 6.098 | 0.002878 | 501.4510 | 9.290 | 0.005599 | 501.6910 | 11.629 | 0.005016 |
| 502.5620 | 6.093 | 0.005501 | 502.4500 | 9.288 | -0.006504 | 502.6900 | 11.621 | 0.009875 |
| 503.5770 | 6.087 | 0.005064 | 503.4640 | 9.285 | 0.012416 | 503.6990 | 11.615 | 0.003105 |
| 504.5840 | 6.082 | 0.005016 | 504.4720 | 9.278 | 0.003223 | 504.7100 | 11.609 | 0.005620 |
| 505.5830 | 6.078 | 0.001630 | 505.4800 | 9.277 | 0.005016 | 505.7120 | 11.607 | -0.001551 |

Table C-7: TGA and DTG for 1wt%, 3wt%, and 5wt% AO in Linear PMMA

| 1wt% AO in Linear PMMA (10C/min) | | | 3wt% AO in Linear PMMA (10C/min) | | | 5wt% AO in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 100.1150 | 100.000 | -0.009769 | 100.0770 | 100.000 | -0.007943 | 100.0990 | 100.000 | 0.003150 |
| 101.0860 | 100.001 | 0.000376 | 101.0530 | 100.003 | 0.005016 | 101.0770 | 100.003 | -0.004312 |
| 102.0720 | 100.000 | -0.004601 | 102.0390 | 100.003 | -0.007379 | 102.0590 | 100.005 | 0.001191 |
| 103.0600 | 100.005 | 0.000178 | 103.0190 | 100.007 | -0.001299 | 103.0450 | 100.009 | -0.005910 |
| 104.0360 | 100.007 | 0.000088 | 104.0100 | 100.004 | -0.001299 | 104.0220 | 100.012 | 0.003217 |
| 105.0210 | 100.006 | 0.000148 | 104.9810 | 99.998 | 0.005016 | 105.0050 | 100.008 | 0.004111 |
| 106.0070 | 100.005 | 0.000236 | 105.9690 | 99.999 | -0.013237 | 105.9920 | 100.004 | -0.003928 |
| 107.0040 | 100.008 | -0.005288 | 106.9590 | 99.998 | 0.005016 | 106.9890 | 100.010 | -0.002539 |
| 107.9910 | 100.007 | 0.005016 | 107.9400 | 99.996 | 0.010685 | 107.9700 | 100.000 | 0.011752 |
| 108.9680 | 100.010 | -0.004264 | 108.9390 | 99.991 | -0.001143 | 108.9670 | 99.998 | -0.001474 |
| 109.9640 | 100.012 | 0.005016 | 109.9120 | 99.994 | 0.005016 | 109.9570 | 99.998 | 0.015277 |
| 110.9480 | 100.008 | 0.005016 | 110.9190 | 99.994 | -0.001182 | 110.9470 | 99.988 | 0.003150 |
| 111.9510 | 100.008 | -0.019323 | 111.9040 | 99.987 | 0.011100 | 111.9410 | 99.984 | 0.011389 |
| 112.9370 | 100.013 | 0.000482 | 112.8890 | 99.981 | -0.000995 | 112.9420 | 99.979 | 0.000464 |
| 113.9350 | 100.011 | 0.000430 | 113.8890 | 99.985 | -0.007079 | 113.9520 | 99.975 | 0.009738 |
| 114.9300 | 100.009 | 0.000236 | 114.8910 | 99.983 | 0.011292 | 114.9570 | 99.968 | 0.010351 |
| 115.9280 | 100.010 | 0.000178 | 115.8870 | 99.970 | 0.011027 | 115.9590 | 99.956 | 0.011314 |
| 116.9170 | 100.009 | 0.000293 | 116.8840 | 99.966 | -0.001143 | 116.9650 | 99.949 | 0.003173 |
| 117.9200 | 100.009 | 0.005016 | 117.8870 | 99.965 | 0.011027 | 117.9720 | 99.944 | 0.009709 |
| 118.9200 | 100.005 | 0.005016 | 118.8940 | 99.957 | 0.005016 | 118.9830 | 99.938 | 0.005016 |
| 119.9190 | 100.002 | -0.004052 | 119.9090 | 99.950 | 0.005016 | 119.9860 | 99.929 | 0.009541 |
| 120.9250 | 100.004 | 0.000088 | 120.9150 | 99.945 | 0.010991 | 120.9960 | 99.926 | 0.002285 |
| 121.9180 | 100.003 | 0.000207 | 121.9340 | 99.936 | 0.010751 | 122.0010 | 99.919 | 0.004089 |
| 122.9110 | 100.001 | 0.000456 | 122.9580 | 99.928 | 0.010955 | 123.0120 | 99.901 | 0.035426 |
| 123.9170 | 100.001 | 0.005016 | 123.9820 | 99.920 | 0.010622 | 124.0140 | 99.889 | -0.010713 |
| 124.9300 | 99.995 | 0.005016 | 125.0270 | 99.911 | -0.001031 | 125.0210 | 99.904 | -0.001554 |
| 125.9250 | 99.995 | -0.004319 | 126.0480 | 99.909 | 0.005016 | 126.0300 | 99.902 | 0.001352 |
| 126.9290 | 99.991 | 0.005016 | 127.0760 | 99.897 | 0.016824 | 127.0300 | 99.904 | -0.000382 |
| 127.9480 | 99.987 | 0.005016 | 128.0850 | 99.893 | -0.000888 | 128.0310 | 99.901 | 0.007715 |
| 128.9550 | 99.980 | 0.000403 | 129.1000 | 99.890 | 0.005016 | 129.0500 | 99.896 | 0.001238 |
| 129.9620 | 99.980 | 0.005016 | 130.1150 | 99.887 | -0.000995 | 130.0550 | 99.896 | 0.001417 |
| 130.9700 | 99.974 | 0.000178 | 131.1170 | 99.879 | 0.005016 | 131.0490 | 99.896 | -0.003824 |
| 131.9920 | 99.969 | 0.005016 | 132.1200 | 99.882 | -0.000752 | 132.0590 | 99.899 | 0.003127 |
| 132.9920 | 99.967 | 0.005016 | 133.1190 | 99.884 | 0.010955 | 133.0740 | 99.893 | 0.003206 |
| 134.0120 | 99.960 | 0.009683 | 134.1350 | 99.875 | 0.005016 | 134.0680 | 99.892 | -0.000963 |
| 135.0240 | 99.955 | -0.004374 | 135.1360 | 99.871 | -0.000959 | 135.0800 | 99.896 | -0.005060 |
| 136.0490 | 99.955 | 0.000533 | 136.1380 | 99.876 | -0.006323 | 136.0960 | 99.898 | -0.005182 |
| 137.0720 | 99.951 | 0.018314 | 137.1400 | 99.879 | 0.005016 | 137.0980 | 99.903 | -0.003130 |
| 138.1010 | 99.941 | 0.000403 | 138.1480 | 99.872 | 0.010885 | 138.1050 | 99.902 | 0.004100 |
| 139.1200 | 99.942 | 0.005016 | 139.1610 | 99.871 | -0.001143 | 139.1160 | 99.898 | 0.004142 |
| 140.1430 | 99.938 | 0.009656 | 140.1620 | 99.870 | 0.010991 | 140.1230 | 99.900 | -0.003278 |
| 141.1620 | 99.930 | 0.000632 | 141.1680 | 99.869 | -0.006863 | 141.1330 | 99.907 | -0.012078 |
| 142.1850 | 99.928 | 0.005016 | 142.1800 | 99.869 | -0.000686 | 142.1490 | 99.911 | 0.001374 |
| 143.1930 | 99.920 | 0.000321 | 143.1780 | 99.870 | 0.005016 | 143.1460 | 99.910 | -0.006476 |
| 144.2210 | 99.921 | 0.005016 | 144.1940 | 99.865 | -0.000785 | 144.1640 | 99.915 | -0.001031 |
| 145.2330 | 99.916 | -0.004264 | 145.2030 | 99.869 | -0.001143 | 145.1790 | 99.916 | -0.000513 |
| 146.2500 | 99.915 | 0.005016 | 146.2130 | 99.860 | -0.000719 | 146.1900 | 99.916 | 0.006794 |
| 147.2620 | 99.911 | -0.004374 | 147.2230 | 99.861 | -0.000853 | 147.2100 | 99.915 | -0.007731 |
| 148.2850 | 99.906 | 0.005016 | 148.2420 | 99.864 | -0.007079 | 148.2070 | 99.919 | -0.003722 |
| 149.2870 | 99.903 | -0.004157 | 149.2450 | 99.862 | 0.005016 | 149.2300 | 99.915 | 0.001374 |
| 150.2950 | 99.901 | 0.005016 | 150.2690 | 99.858 | -0.007079 | 150.2510 | 99.915 | -0.008244 |
| 151.3220 | 99.895 | 0.005016 | 151.2790 | 99.858 | -0.000752 | 151.2620 | 99.924 | -0.003981 |
| 152.3280 | 99.894 | 0.000293 | 152.2900 | 99.861 | -0.001031 | 152.2800 | 99.924 | -0.004199 |
| 153.3370 | 99.889 | 0.009796 | 153.3040 | 99.855 | 0.005016 | 153.3010 | 99.929 | -0.002312 |
| 154.3480 | 99.885 | -0.004210 | 154.3200 | 99.855 | -0.000558 | 154.3080 | 99.926 | 0.004132 |
| 155.3750 | 99.885 | 0.005016 | 155.3450 | 99.851 | -0.000995 | 155.3300 | 99.922 | -0.002097 |
| 156.3820 | 99.880 | 0.005016 | 156.3520 | 99.856 | 0.005016 | 156.3470 | 99.928 | -0.004708 |
| 157.3950 | 99.874 | 0.005016 | 157.3770 | 99.846 | 0.010991 | 157.3620 | 99.927 | 0.004142 |
| 158.4140 | 99.872 | 0.005016 | 158.3910 | 99.844 | -0.000995 | 158.3890 | 99.927 | 0.004089 |
| 159.4370 | 99.867 | 0.000403 | 159.4060 | 99.847 | -0.000819 | 159.3980 | 99.919 | 0.005861 |
| 160.4570 | 99.866 | 0.009711 | 160.4260 | 99.843 | 0.010685 | 160.4240 | 99.919 | -0.004652 |
| 161.4730 | 99.856 | 0.000403 | 161.4460 | 99.838 | -0.000923 | 161.4360 | 99.922 | -0.001935 |
| 162.4950 | 99.855 | 0.014811 | 162.4660 | 99.834 | 0.005016 | 162.4670 | 99.923 | 0.002183 |
| 163.5110 | 99.848 | 0.000207 | 163.4800 | 99.836 | -0.000819 | 163.4800 | 99.917 | 0.001352 |
| 164.5280 | 99.844 | 0.009656 | 164.4990 | 99.832 | 0.005016 | 164.5010 | 99.917 | 0.000380 |
| 165.5470 | 99.840 | 0.005016 | 165.5240 | 99.827 | 0.005016 | 165.5160 | 99.908 | 0.004176 |

Table C-7: Continued

| 1wt% AO in Linear PMMA (10C/min) | | | 3wt% AO in Linear PMMA (10C/min) | | | 5wt% AO in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 166.5730 | 99.836 | 0.009739 | 166.5440 | 99.819 | 0.005016 | 166.5420 | 99.908 | -0.000414 |
| 167.5890 | 99.826 | 0.005016 | 167.5680 | 99.819 | 0.005016 | 167.5670 | 99.905 | 0.004077 |
| 168.6140 | 99.821 | 0.005016 | 168.5920 | 99.813 | -0.000785 | 168.5870 | 99.900 | 0.005016 |
| 169.6320 | 99.816 | 0.005016 | 169.6120 | 99.808 | 0.011063 | 169.6070 | 99.895 | 0.005016 |
| 170.6560 | 99.811 | 0.005016 | 170.6270 | 99.799 | -0.000752 | 170.6290 | 99.890 | 0.005016 |
| 171.6680 | 99.800 | 0.005016 | 171.6510 | 99.797 | 0.005016 | 171.6500 | 99.882 | 0.005016 |
| 172.6920 | 99.798 | 0.005016 | 172.6720 | 99.792 | 0.005016 | 172.6750 | 99.879 | 0.004142 |
| 173.7200 | 99.789 | 0.014242 | 173.7020 | 99.778 | 0.016824 | 173.7030 | 99.875 | 0.004100 |
| 174.7460 | 99.777 | 0.005016 | 174.7220 | 99.772 | -0.000959 | 174.7180 | 99.870 | 0.005016 |
| 175.7710 | 99.770 | 0.009711 | 175.7460 | 99.772 | 0.005016 | 175.7400 | 99.862 | 0.013704 |
| 176.7930 | 99.759 | 0.014518 | 176.7640 | 99.766 | 0.010751 | 176.7760 | 99.849 | 0.009680 |
| 177.8200 | 99.749 | 0.009767 | 177.7960 | 99.753 | -0.000853 | 177.8000 | 99.842 | 0.012881 |
| 178.8500 | 99.742 | 0.014996 | 178.8180 | 99.752 | 0.005016 | 178.8170 | 99.830 | 0.004127 |
| 179.8700 | 99.731 | 0.014462 | 179.8270 | 99.742 | 0.010559 | 179.8430 | 99.824 | 0.013019 |
| 180.8850 | 99.720 | 0.005016 | 180.8610 | 99.731 | 0.010718 | 180.8760 | 99.811 | 0.010512 |
| 181.9110 | 99.710 | 0.014462 | 181.8880 | 99.717 | 0.005016 | 181.8990 | 99.798 | 0.014579 |
| 182.9330 | 99.696 | 0.009473 | 182.9190 | 99.708 | 0.005016 | 182.9180 | 99.793 | 0.005885 |
| 183.9550 | 99.685 | 0.014406 | 183.9390 | 99.704 | 0.005016 | 183.9560 | 99.782 | 0.014519 |
| 184.9820 | 99.674 | 0.014189 | 184.9650 | 99.696 | 0.010991 | 184.9700 | 99.766 | 0.014740 |
| 186.0080 | 99.663 | 0.009576 | 185.9780 | 99.683 | 0.022834 | 185.9980 | 99.754 | 0.005916 |
| 187.0290 | 99.651 | 0.014462 | 187.0110 | 99.666 | 0.005016 | 187.0160 | 99.745 | 0.014573 |
| 188.0550 | 99.634 | 0.014189 | 188.0220 | 99.659 | 0.005016 | 188.0500 | 99.728 | 0.018592 |
| 189.0830 | 99.625 | 0.014351 | 189.0540 | 99.646 | 0.016291 | 189.0700 | 99.709 | 0.016908 |
| 190.1030 | 99.609 | 0.018696 | 190.0790 | 99.634 | 0.010685 | 190.0950 | 99.694 | 0.015686 |
| 191.1350 | 99.593 | 0.009884 | 191.1120 | 99.625 | 0.005016 | 191.1140 | 99.680 | 0.007653 |
| 192.1570 | 99.579 | 0.014692 | 192.1330 | 99.617 | 0.010784 | 192.1480 | 99.673 | 0.017763 |
| 193.1830 | 99.563 | 0.014462 | 193.1500 | 99.601 | 0.010653 | 193.1710 | 99.656 | 0.019456 |
| 194.2110 | 99.546 | 0.009767 | 194.1820 | 99.588 | 0.016551 | 194.2050 | 99.636 | 0.017069 |
| 195.2350 | 99.533 | 0.009576 | 195.2060 | 99.575 | 0.011371 | 195.2210 | 99.619 | 0.017612 |
| 196.2590 | 99.519 | 0.023907 | 196.2260 | 99.562 | 0.010920 | 196.2490 | 99.600 | 0.026999 |
| 197.2780 | 99.498 | 0.014575 | 197.2490 | 99.546 | 0.016291 | 197.2610 | 99.578 | 0.013856 |
| 198.3020 | 99.482 | 0.019101 | 198.2780 | 99.529 | 0.011175 | 198.2850 | 99.564 | 0.019243 |
| 199.3250 | 99.466 | 0.018464 | 199.2950 | 99.521 | 0.010622 | 199.3170 | 99.548 | 0.022100 |
| 200.3550 | 99.446 | 0.024729 | 200.3290 | 99.506 | 0.016618 | 200.3420 | 99.526 | 0.020494 |
| 201.3940 | 99.428 | 0.014751 | 201.3590 | 99.489 | 0.017111 | 201.3690 | 99.500 | 0.018511 |
| 202.4110 | 99.408 | 0.019184 | 202.3800 | 99.468 | 0.010991 | 202.3900 | 99.484 | 0.021619 |
| 203.4430 | 99.390 | 0.019619 | 203.4140 | 99.456 | 0.011027 | 203.4230 | 99.458 | 0.028831 |
| 204.4660 | 99.367 | 0.018855 | 204.4390 | 99.442 | 0.016686 | 204.4500 | 99.426 | 0.032819 |
| 205.4990 | 99.351 | 0.023152 | 205.4750 | 99.420 | 0.022521 | 205.4760 | 99.393 | 0.029625 |
| 206.5280 | 99.327 | 0.019184 | 206.5060 | 99.399 | 0.011027 | 206.5020 | 99.363 | 0.033000 |
| 207.5580 | 99.304 | 0.023468 | 207.5250 | 99.388 | 0.016686 | 207.5330 | 99.333 | 0.019326 |
| 208.5810 | 99.283 | 0.023361 | 208.5530 | 99.369 | 0.022834 | 208.5630 | 99.311 | 0.034327 |
| 209.6210 | 99.262 | 0.023796 | 209.5870 | 99.344 | 0.022024 | 209.5950 | 99.277 | 0.029308 |
| 210.6430 | 99.235 | 0.027816 | 210.6120 | 99.327 | 0.016618 | 210.6190 | 99.251 | 0.032420 |
| 211.6760 | 99.210 | 0.018936 | 211.6480 | 99.309 | 0.022220 | 211.6490 | 99.216 | 0.029913 |
| 212.7030 | 99.186 | 0.023576 | 212.6690 | 99.288 | 0.028087 | 212.6710 | 99.185 | 0.029344 |
| 213.7340 | 99.157 | 0.027948 | 213.7090 | 99.258 | 0.016895 | 213.7070 | 99.154 | 0.030213 |
| 214.7560 | 99.130 | 0.027948 | 214.7360 | 99.241 | 0.022319 | 214.7390 | 99.120 | 0.038222 |
| 215.7880 | 99.106 | 0.023049 | 215.7640 | 99.220 | 0.023049 | 215.7730 | 99.080 | 0.028210 |
| 216.8270 | 99.074 | 0.028915 | 216.8010 | 99.196 | 0.019756 | 216.8000 | 99.047 | 0.038805 |
| 217.8500 | 99.044 | 0.023576 | 217.8280 | 99.171 | 0.026733 | 217.8370 | 99.008 | 0.032068 |
| 218.8850 | 99.015 | 0.029059 | 218.8570 | 99.142 | 0.022024 | 218.8600 | 98.971 | 0.037598 |
| 219.9120 | 98.988 | 0.036573 | 219.8950 | 99.122 | 0.024733 | 219.8930 | 98.932 | 0.035611 |
| 220.9430 | 98.953 | 0.028772 | 220.9200 | 99.093 | 0.028260 | 220.9270 | 98.892 | 0.042164 |
| 221.9710 | 98.921 | 0.031761 | 221.9540 | 99.064 | 0.029060 | 221.9560 | 98.846 | 0.044603 |
| 223.0020 | 98.889 | 0.027816 | 222.9860 | 99.039 | 0.023211 | 222.9790 | 98.802 | 0.041260 |
| 224.0380 | 98.855 | 0.041920 | 224.0140 | 99.013 | 0.031244 | 224.0100 | 98.756 | 0.044939 |
| 225.0670 | 98.819 | 0.033020 | 225.0400 | 98.978 | 0.033278 | 225.0390 | 98.710 | 0.047302 |
| 226.1030 | 98.783 | 0.037307 | 226.0680 | 98.948 | 0.028393 | 226.0700 | 98.660 | 0.043933 |
| 227.1250 | 98.744 | 0.041081 | 227.1010 | 98.920 | 0.025780 | 227.0960 | 98.612 | 0.046250 |
| 228.1590 | 98.702 | 0.036936 | 228.1270 | 98.892 | 0.032175 | 228.1230 | 98.562 | 0.048708 |
| 229.1950 | 98.664 | 0.036753 | 229.1620 | 98.852 | 0.037298 | 229.1570 | 98.511 | 0.052142 |
| 230.2210 | 98.622 | 0.041920 | 230.1900 | 98.815 | 0.035857 | 230.1850 | 98.457 | 0.049898 |
| 231.2500 | 98.577 | 0.041287 | 231.2170 | 98.780 | 0.029534 | 231.2110 | 98.403 | 0.054825 |
| 232.2830 | 98.536 | 0.043254 | 232.2530 | 98.764 | -0.012968 | 232.2410 | 98.345 | 0.052803 |
| 233.3090 | 98.488 | 0.048558 | 233.2770 | 98.783 | 0.297825 | 233.2640 | 98.291 | 0.055699 |

Table C-7: Continued

| 1wt% AO in Linear PMMA (10C/min) | | | 3wt% AO in Linear PMMA (10C/min) | | | 5wt% AO in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 234.3330 | 98.443 | 0.040477 | 234.3100 | 98.607 | 0.088949 | 234.3050 | 98.229 | 0.058414 |
| 235.3600 | 98.392 | 0.049843 | 235.3390 | 98.546 | 0.039646 | 235.3280 | 98.171 | 0.059754 |
| 236.3950 | 98.340 | 0.056356 | 236.3650 | 98.496 | 0.050478 | 236.3620 | 98.105 | 0.071365 |
| 237.4210 | 98.291 | 0.028490 | 237.3970 | 98.443 | 0.057023 | 237.3970 | 98.043 | 0.059385 |
| 238.4430 | 98.234 | 0.152113 | 238.4260 | 98.393 | 0.041929 | 238.4230 | 97.983 | 0.057447 |
| 239.4770 | 98.128 | 0.073811 | 239.4490 | 98.350 | 0.053746 | 239.4490 | 97.917 | 0.066560 |
| 240.5070 | 98.000 | 0.156365 | 240.4770 | 98.292 | 0.053448 | 240.4800 | 97.852 | 0.060622 |
| 241.5440 | 97.874 | 0.089027 | 241.5050 | 98.238 | 0.057774 | 241.5110 | 97.781 | 0.075674 |
| 242.5590 | 97.795 | 0.067774 | 242.5280 | 98.183 | 0.048809 | 242.5430 | 97.705 | 0.071481 |
| 243.5960 | 97.699 | 0.118364 | 243.5690 | 98.128 | 0.053166 | 243.5630 | 97.633 | 0.070933 |
| 244.6250 | 97.560 | 0.139575 | 244.5930 | 98.073 | 0.057876 | 244.5950 | 97.556 | 0.076150 |
| 245.6540 | 97.424 | 0.108303 | 245.6210 | 98.011 | 0.060450 | 245.6210 | 97.481 | 0.076150 |
| 246.6800 | 97.299 | 0.125655 | 246.6500 | 97.947 | 0.058193 | 246.6520 | 97.400 | 0.077585 |
| 247.7060 | 97.171 | 0.134069 | 247.6790 | 97.887 | 0.057472 | 247.6830 | 97.322 | 0.081956 |
| 248.7400 | 97.050 | 0.114291 | 248.7040 | 97.823 | 0.066812 | 248.7060 | 97.238 | 0.073438 |
| 249.7660 | 96.929 | 0.132532 | 249.7400 | 97.803 | -0.146722 | 249.7350 | 97.159 | 0.083632 |
| 250.7880 | 96.796 | 0.145034 | 250.7600 | 97.646 | 0.180741 | 250.7590 | 97.072 | 0.076769 |
| 251.8190 | 96.652 | 0.123794 | 251.7970 | 97.511 | 0.105398 | 251.7850 | 96.993 | 0.078067 |
| 252.8440 | 96.521 | 0.135699 | 252.8190 | 97.417 | 0.086757 | 252.8230 | 96.908 | 0.087952 |
| 253.8760 | 96.385 | 0.130804 | 253.8490 | 97.326 | 0.089262 | 253.8350 | 96.818 | 0.083575 |
| 254.9020 | 96.257 | 0.126365 | 254.8760 | 97.238 | 0.083456 | 254.8710 | 96.729 | 0.085765 |
| 255.9260 | 96.129 | 0.127432 | 255.9040 | 97.151 | 0.086872 | 255.9120 | 96.632 | 0.110907 |
| 256.9510 | 95.988 | 0.143406 | 256.9220 | 97.064 | 0.081990 | 256.9300 | 96.526 | 0.102825 |
| 257.9810 | 95.847 | 0.124261 | 257.9470 | 96.976 | 0.086959 | 257.9590 | 96.426 | 0.086562 |
| 259.0150 | 95.711 | 0.134180 | 258.9800 | 96.880 | 0.095726 | 258.9880 | 96.329 | 0.095022 |
| 260.0350 | 95.569 | 0.140261 | 260.0100 | 96.790 | 0.090793 | 260.0160 | 96.232 | 0.091032 |
| 261.0660 | 95.423 | 0.135752 | 261.0370 | 96.693 | 0.104797 | 261.0340 | 96.133 | 0.095896 |
| 262.0890 | 95.283 | 0.141168 | 262.0620 | 96.589 | 0.104210 | 262.0750 | 96.036 | 0.098656 |
| 263.1210 | 95.146 | 0.137255 | 263.0870 | 96.481 | 0.101930 | 263.0980 | 95.933 | 0.107873 |
| 264.1430 | 95.005 | 0.129826 | 264.1190 | 96.374 | 0.112904 | 264.1180 | 95.831 | 0.094663 |
| 265.1770 | 94.865 | 0.141978 | 265.1390 | 96.264 | 0.105950 | 265.1470 | 95.730 | 0.105793 |
| 266.1990 | 94.724 | 0.138047 | 266.1640 | 96.151 | 0.107681 | 266.1790 | 95.624 | 0.097300 |
| 267.2300 | 94.584 | 0.146701 | 267.1920 | 96.040 | 0.103669 | 267.2130 | 95.525 | 0.103939 |
| 268.2560 | 94.440 | 0.133433 | 268.2200 | 95.931 | 0.104210 | 268.2280 | 95.420 | 0.107899 |
| 269.2830 | 94.304 | 0.139575 | 269.2450 | 95.827 | 0.103637 | 269.2570 | 95.311 | 0.101139 |
| 270.3050 | 94.166 | 0.131778 | 270.2700 | 95.717 | 0.106537 | 270.2780 | 95.209 | 0.100816 |
| 271.3390 | 94.028 | 0.139659 | 271.3030 | 95.610 | 0.107767 | 271.3020 | 95.101 | 0.111097 |
| 272.3590 | 93.891 | 0.128135 | 272.3270 | 95.507 | 0.098416 | 272.3240 | 94.991 | 0.104664 |
| 273.3820 | 93.760 | 0.133296 | 273.3490 | 95.401 | 0.106527 | 273.3500 | 94.880 | 0.113869 |
| 274.4100 | 93.628 | 0.118990 | 274.3790 | 95.290 | 0.105978 | 274.3770 | 94.764 | 0.106677 |
| 275.4380 | 93.499 | 0.124954 | 275.3990 | 95.187 | 0.095048 | 275.4000 | 94.658 | 0.106382 |
| 276.4630 | 93.372 | 0.121015 | 276.4270 | 95.091 | 0.095104 | 276.4310 | 94.548 | 0.104572 |
| 277.4900 | 93.245 | 0.121698 | 277.4520 | 94.987 | 0.096905 | 277.4580 | 94.444 | 0.108160 |
| 278.5090 | 93.120 | 0.110807 | 278.4800 | 94.886 | 0.093901 | 278.4830 | 94.331 | 0.112563 |
| 279.5440 | 93.002 | 0.118364 | 279.5110 | 94.792 | 0.091376 | 279.5080 | 94.218 | 0.112241 |
| 280.5660 | 92.881 | 0.107538 | 280.5280 | 94.697 | 0.094355 | 280.5230 | 94.108 | 0.099833 |
| 281.6000 | 92.768 | 0.115088 | 281.5560 | 94.597 | 0.096531 | 281.5620 | 93.999 | 0.114633 |
| 282.6220 | 92.655 | 0.099687 | 282.5820 | 94.504 | 0.091034 | 282.5900 | 93.887 | 0.110424 |
| 283.6500 | 92.549 | 0.108704 | 283.6050 | 94.407 | 0.089860 | 283.6020 | 93.778 | 0.116868 |
| 284.6800 | 92.439 | 0.104762 | 284.6270 | 94.320 | 0.082247 | 284.6300 | 93.659 | 0.109050 |
| 285.6990 | 92.332 | 0.107095 | 285.6540 | 94.227 | 0.092685 | 285.6510 | 93.548 | 0.111362 |
| 286.7310 | 92.230 | 0.096381 | 286.6820 | 94.132 | 0.084360 | 286.6850 | 93.437 | 0.110068 |
| 287.7590 | 92.134 | 0.098361 | 287.7020 | 94.050 | 0.074749 | 287.7020 | 93.327 | 0.108767 |
| 288.7790 | 92.039 | 0.090671 | 288.7400 | 93.970 | 0.089399 | 288.7290 | 93.213 | 0.111450 |
| 289.8060 | 91.945 | 0.087570 | 289.7550 | 93.884 | 0.079565 | 289.7560 | 93.101 | 0.118820 |
| 290.8390 | 91.855 | 0.086626 | 290.7780 | 93.804 | 0.071730 | 290.7730 | 92.983 | 0.119752 |
| 291.8570 | 91.766 | 0.087570 | 291.8060 | 93.730 | 0.071935 | 291.8010 | 92.870 | 0.107241 |
| 292.8890 | 91.683 | 0.084858 | 292.8270 | 93.657 | 0.080753 | 292.8190 | 92.758 | 0.114633 |
| 293.9080 | 91.601 | 0.082093 | 293.8450 | 93.578 | 0.073791 | 293.8380 | 92.640 | 0.108959 |
| 294.9350 | 91.513 | 0.075439 | 294.8810 | 93.502 | 0.064662 | 294.8750 | 92.524 | 0.112345 |
| 295.9590 | 91.439 | 0.075025 | 295.9050 | 93.436 | 0.066466 | 295.8960 | 92.415 | 0.106672 |
| 296.9860 | 91.360 | 0.069225 | 296.9230 | 93.369 | 0.069990 | 296.9190 | 92.302 | 0.109050 |
| 298.0050 | 91.284 | 0.072638 | 297.9490 | 93.300 | 0.066191 | 297.9420 | 92.191 | 0.109939 |
| 299.0380 | 91.212 | 0.071136 | 298.9750 | 93.235 | 0.060189 | 298.9600 | 92.073 | 0.112395 |
| 300.0530 | 91.138 | 0.073025 | 299.9930 | 93.175 | 0.063028 | 299.9900 | 91.959 | 0.108445 |

Table C-7: Continued

| 1wt% AO in Linear PMMA (10C/min) | | | 3wt% AO in Linear PMMA (10C/min) | | | 5wt% AO in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 301.0780 | 91.066 | 0.060372 | 301.0170 | 93.108 | 0.061106 | 301.0090 | 91.845 | 0.115433 |
| 302.1050 | 90.997 | 0.061690 | 302.0420 | 93.047 | 0.060641 | 302.0320 | 91.733 | 0.107540 |
| 303.1300 | 90.928 | 0.072748 | 303.0680 | 92.983 | 0.059114 | 303.0580 | 91.618 | 0.118825 |
| 304.1570 | 90.859 | 0.066780 | 304.0860 | 92.931 | 0.051827 | 304.0800 | 91.504 | 0.110351 |
| 305.1800 | 90.793 | 0.064985 | 305.1030 | 92.876 | 0.057174 | 305.0990 | 91.390 | 0.123078 |
| 306.1980 | 90.726 | 0.055466 | 306.1370 | 92.813 | 0.061180 | 306.1260 | 91.272 | 0.109381 |
| 307.2200 | 90.666 | 0.067774 | 307.1530 | 92.760 | 0.046102 | 307.1450 | 91.159 | 0.116401 |
| 308.2470 | 90.602 | 0.065336 | 308.1770 | 92.712 | 0.054031 | 308.1660 | 91.041 | 0.115360 |
| 309.2630 | 90.537 | 0.061023 | 309.1920 | 92.656 | 0.059283 | 309.1890 | 90.916 | 0.118830 |
| 310.2940 | 90.473 | 0.061355 | 310.2120 | 92.595 | 0.052311 | 310.2070 | 90.798 | 0.116763 |
| 311.3120 | 90.406 | 0.059423 | 311.2350 | 92.548 | 0.041929 | 311.2290 | 90.678 | 0.128670 |
| 312.3330 | 90.342 | 0.067529 | 312.2540 | 92.500 | 0.055500 | 312.2480 | 90.553 | 0.126282 |
| 313.3460 | 90.274 | 0.067529 | 313.2700 | 92.448 | 0.054333 | 313.2690 | 90.426 | 0.136124 |
| 314.3710 | 90.201 | 0.074211 | 314.2980 | 92.389 | 0.051972 | 314.2820 | 90.293 | 0.125964 |
| 315.3940 | 90.130 | 0.068296 | 315.3230 | 92.337 | 0.054906 | 315.3080 | 90.158 | 0.134965 |
| 316.4100 | 90.055 | 0.077976 | 316.3370 | 92.281 | 0.051300 | 316.3310 | 90.017 | 0.135725 |
| 317.4340 | 89.973 | 0.082535 | 317.3540 | 92.226 | 0.060386 | 317.3500 | 89.875 | 0.148721 |
| 318.4520 | 89.884 | 0.087262 | 318.3740 | 92.163 | 0.052473 | 318.3620 | 89.719 | 0.150074 |
| 319.4680 | 89.797 | 0.092663 | 319.3870 | 92.105 | 0.056902 | 319.3860 | 89.567 | 0.151667 |
| 320.4920 | 89.696 | 0.103608 | 320.4110 | 92.047 | 0.053448 | 320.3990 | 89.409 | 0.161511 |
| 321.5140 | 89.587 | 0.115616 | 321.4290 | 91.978 | 0.076117 | 321.4170 | 89.239 | 0.174261 |
| 322.5230 | 89.466 | 0.127809 | 322.4510 | 91.899 | 0.082623 | 322.4370 | 89.059 | 0.182701 |
| 323.5380 | 89.331 | 0.140367 | 323.4640 | 91.820 | 0.072324 | 323.4590 | 88.863 | 0.204349 |
| 324.5540 | 89.180 | 0.167527 | 324.4780 | 91.744 | 0.097627 | 324.4680 | 88.659 | 0.205363 |
| 325.5630 | 89.009 | 0.171084 | 325.4920 | 91.642 | 0.100129 | 325.4840 | 88.447 | 0.213413 |
| 326.5770 | 88.817 | 0.203375 | 326.5130 | 91.537 | 0.113301 | 326.5040 | 88.222 | 0.225402 |
| 327.5930 | 88.601 | 0.220573 | 327.5300 | 91.415 | 0.126436 | 327.5230 | 87.982 | 0.237045 |
| 328.6020 | 88.362 | 0.261576 | 328.5420 | 91.281 | 0.164542 | 328.5370 | 87.729 | 0.253422 |
| 329.6080 | 88.097 | 0.274134 | 329.5580 | 91.115 | 0.183412 | 329.5570 | 87.463 | 0.272912 |
| 330.6200 | 87.800 | 0.323340 | 330.5640 | 90.924 | 0.193682 | 330.5690 | 87.178 | 0.308192 |
| 331.6370 | 87.470 | 0.341059 | 331.5800 | 90.704 | 0.224534 | 331.5840 | 86.872 | 0.329070 |
| 332.6430 | 87.103 | 0.394520 | 332.5870 | 90.453 | 0.265981 | 332.5890 | 86.552 | 0.316979 |
| 333.6500 | 86.710 | 0.416248 | 333.6030 | 90.158 | 0.322111 | 333.6160 | 86.208 | 0.363815 |
| 334.6550 | 86.283 | 0.448962 | 334.6060 | 89.830 | 0.342598 | 334.6220 | 85.839 | 0.380190 |
| 335.6630 | 85.825 | 0.476268 | 335.6120 | 89.464 | 0.368060 | 335.6380 | 85.450 | 0.413943 |
| 336.6710 | 85.339 | 0.527522 | 336.6280 | 89.056 | 0.421957 | 336.6560 | 85.034 | 0.451087 |
| 337.6830 | 84.811 | 0.529333 | 337.6320 | 88.611 | 0.467636 | 337.6610 | 84.587 | 0.427661 |
| 338.6890 | 84.254 | 0.598875 | 338.6380 | 88.130 | 0.490341 | 338.6700 | 84.126 | 0.469119 |
| 339.6920 | 83.660 | 0.613158 | 339.6410 | 87.615 | 0.465854 | 339.6960 | 83.531 | 0.735034 |
| 340.6980 | 83.026 | 0.688668 | 340.6480 | 86.808 | 0.944025 | 340.6960 | 82.775 | 0.667390 |
| 341.6960 | 82.348 | 0.691732 | 341.6560 | 85.905 | 0.822240 | 341.7140 | 82.077 | 0.680292 |
| 342.7000 | 81.592 | 0.911099 | 342.6520 | 85.092 | 0.786341 | 342.7230 | 81.379 | 0.706640 |
| 343.6980 | 80.621 | 0.940984 | 343.6650 | 84.287 | 0.828817 | 343.7300 | 80.662 | 0.712221 |
| 344.7070 | 79.712 | 0.903605 | 344.6600 | 83.454 | 0.808900 | 344.7440 | 79.910 | 0.736752 |
| 345.7060 | 78.810 | 0.927504 | 345.6730 | 82.568 | 0.946507 | 345.7560 | 79.103 | 0.855364 |
| 346.7000 | 77.834 | 1.032231 | 346.6750 | 81.617 | 1.025200 | 346.7580 | 78.254 | 0.867827 |
| 347.7050 | 76.734 | 1.136983 | 347.6710 | 80.562 | 0.996658 | 347.7700 | 77.349 | 0.904714 |
| 348.7050 | 75.606 | 1.122909 | 348.6780 | 79.501 | 1.083859 | 348.7800 | 76.423 | 0.930805 |
| 349.6980 | 74.465 | 1.144464 | 349.6770 | 78.408 | 1.133862 | 349.7880 | 75.466 | 0.966183 |
| 350.6900 | 73.288 | 1.169649 | 350.6870 | 77.270 | 1.158770 | 350.7930 | 74.463 | 1.044628 |
| 351.6890 | 72.068 | 1.220521 | 351.6850 | 76.085 | 1.225829 | 351.8050 | 73.391 | 1.059635 |
| 352.6870 | 70.811 | 1.290862 | 352.6850 | 74.856 | 1.209308 | 352.8100 | 72.286 | 1.078148 |
| 353.6830 | 69.507 | 1.284720 | 353.6900 | 73.580 | 1.287407 | 353.8180 | 71.153 | 1.185469 |
| 354.6810 | 68.174 | 1.306616 | 354.6960 | 72.263 | 1.361184 | 354.8360 | 69.959 | 1.251258 |
| 355.6870 | 66.799 | 1.382025 | 355.6910 | 70.910 | 1.367500 | 355.8430 | 68.718 | 1.311687 |
| 356.6840 | 65.382 | 1.450510 | 356.6880 | 69.511 | 1.446094 | 356.8390 | 67.455 | 1.264851 |
| 357.6810 | 63.930 | 1.453268 | 357.6900 | 68.064 | 1.448275 | 357.8480 | 66.170 | 1.287594 |
| 358.6840 | 62.434 | 1.470319 | 358.7000 | 66.587 | 1.476190 | 358.8620 | 64.851 | 1.350279 |
| 359.6730 | 60.909 | 1.518110 | 359.7010 | 65.090 | 1.513081 | 359.8670 | 63.519 | 1.309954 |
| 360.6770 | 59.340 | 1.547342 | 360.7020 | 63.549 | 1.532431 | 360.8740 | 62.169 | 1.382672 |
| 361.6770 | 57.742 | 1.634202 | 361.7080 | 61.988 | 1.565874 | 361.8820 | 60.795 | 1.375278 |
| 362.6810 | 56.114 | 1.600238 | 362.7090 | 60.393 | 1.553360 | 362.8960 | 59.404 | 1.405324 |
| 363.6840 | 54.457 | 1.701524 | 363.7180 | 58.781 | 1.660889 | 363.9030 | 57.991 | 1.378792 |
| 364.6830 | 52.768 | 1.673577 | 364.7180 | 57.142 | 1.663193 | 364.9180 | 56.570 | 1.448099 |
| 365.6870 | 51.069 | 1.671229 | 365.7250 | 55.490 | 1.568628 | 365.9200 | 55.124 | 1.465608 |

Table C-7: Continued

| 1wt% AO in Linear PMMA (10C/min) | | | 3wt% AO in Linear PMMA (10C/min) | | | 5wt% AO in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 366.6950 | 49.366 | 1.699868 | 366.7370 | 53.836 | 1.721247 | 366.9310 | 53.670 | 1.405976 |
| 367.7020 | 47.627 | 1.794163 | 367.7390 | 52.176 | 1.637901 | 367.9440 | 52.196 | 1.527372 |
| 368.6990 | 45.883 | 1.716770 | 368.7430 | 50.496 | 1.640958 | 368.9490 | 50.704 | 1.487952 |
| 369.7180 | 44.141 | 1.805768 | 369.7600 | 48.809 | 1.624135 | 369.9670 | 49.230 | 1.462683 |
| 370.7210 | 42.390 | 1.745347 | 370.7650 | 47.139 | 1.685061 | 370.9680 | 47.769 | 1.428586 |
| 371.7330 | 40.644 | 1.687282 | 371.7740 | 45.461 | 1.715982 | 371.9920 | 46.307 | 1.451758 |
| 372.7350 | 38.883 | 1.680297 | 372.7870 | 43.787 | 1.694598 | 372.9990 | 44.859 | 1.453628 |
| 373.7410 | 37.122 | 1.667172 | 373.7950 | 42.127 | 1.635364 | 374.0140 | 43.424 | 1.443492 |
| 374.7540 | 35.356 | 1.737897 | 374.8090 | 40.484 | 1.605618 | 375.0230 | 41.995 | 1.363845 |
| 375.7660 | 33.605 | 1.705300 | 375.8240 | 38.856 | 1.638623 | 376.0440 | 40.594 | 1.348414 |
| 376.7850 | 31.881 | 1.694371 | 376.8420 | 37.257 | 1.526094 | 377.0590 | 39.232 | 1.343047 |
| 377.7970 | 30.187 | 1.641826 | 377.8510 | 35.691 | 1.494808 | 378.0750 | 37.878 | 1.326112 |
| 378.8220 | 28.547 | 1.547857 | 378.8710 | 34.152 | 1.448971 | 379.0970 | 36.567 | 1.293812 |
| 379.8510 | 26.960 | 1.528411 | 379.8930 | 32.649 | 1.469063 | 380.1110 | 35.282 | 1.200674 |
| 380.8780 | 25.432 | 1.543398 | 380.9140 | 31.191 | 1.414347 | 381.1350 | 34.035 | 1.196365 |
| 381.9020 | 23.958 | 1.360131 | 381.9400 | 29.790 | 1.411803 | 382.1500 | 32.821 | 1.159166 |
| 382.9350 | 22.546 | 1.360032 | 382.9590 | 28.445 | 1.262599 | 383.1770 | 31.654 | 1.102258 |
| 383.9680 | 21.198 | 1.297986 | 383.9840 | 27.154 | 1.224304 | 384.1920 | 30.534 | 1.064055 |
| 385.0080 | 19.910 | 1.285422 | 385.0120 | 25.914 | 1.153643 | 385.2160 | 29.459 | 1.034761 |
| 386.0310 | 18.698 | 1.139813 | 386.0360 | 24.753 | 1.081961 | 386.2390 | 28.443 | 0.962030 |
| 387.0700 | 17.550 | 1.090794 | 387.0750 | 23.643 | 1.071313 | 387.2520 | 27.489 | 0.906449 |
| 388.0990 | 16.471 | 1.039315 | 388.0990 | 22.580 | 1.009243 | 388.2840 | 26.591 | 0.847065 |
| 389.1340 | 15.455 | 0.910439 | 389.1360 | 21.572 | 0.981787 | 389.3100 | 25.743 | 0.821816 |
| 390.1670 | 14.516 | 0.844107 | 390.1560 | 20.627 | 0.905420 | 390.3380 | 24.954 | 0.738429 |
| 391.2020 | 13.638 | 0.813475 | 391.1890 | 19.736 | 0.843871 | 391.3580 | 24.227 | 0.681589 |
| 392.2360 | 12.829 | 0.744187 | 392.2210 | 18.894 | 0.778031 | 392.3890 | 23.550 | 0.665154 |
| 393.2750 | 12.082 | 0.675745 | 393.2550 | 18.100 | 0.750472 | 393.4040 | 22.933 | 0.587426 |
| 394.3090 | 11.395 | 0.635612 | 394.2830 | 17.357 | 0.704080 | 394.4300 | 22.359 | 0.551094 |
| 395.3440 | 10.769 | 0.575097 | 395.3120 | 16.673 | 0.641191 | 395.4520 | 21.843 | 0.479945 |
| 396.3830 | 10.201 | 0.516392 | 396.3390 | 16.026 | 0.576488 | 396.4730 | 21.377 | 0.425335 |
| 397.4240 | 9.687 | 0.487144 | 397.3700 | 15.430 | 0.543717 | 397.5010 | 20.952 | 0.396253 |
| 398.4490 | 9.215 | 0.432357 | 398.3990 | 14.895 | 0.469891 | 398.5240 | 20.564 | 0.349311 |
| 399.4870 | 8.791 | 0.395666 | 399.4370 | 14.413 | 0.467855 | 399.5430 | 20.219 | 0.305716 |
| 400.5210 | 8.410 | 0.344532 | 400.4570 | 13.966 | 0.396554 | 400.5660 | 19.915 | 0.276406 |
| 401.5510 | 8.070 | 0.310534 | 401.4830 | 13.568 | 0.359410 | 401.5880 | 19.642 | 0.274470 |
| 402.5850 | 7.767 | 0.275990 | 402.5170 | 13.216 | 0.312723 | 402.6030 | 19.395 | 0.231279 |
| 403.6160 | 7.499 | 0.253499 | 403.5360 | 12.902 | 0.279413 | 403.6240 | 19.175 | 0.209247 |
| 404.6500 | 7.263 | 0.217843 | 404.5630 | 12.626 | 0.236300 | 404.6430 | 18.980 | 0.175166 |
| 405.6760 | 7.053 | 0.184800 | 405.5910 | 12.387 | 0.225264 | 405.6630 | 18.812 | 0.159764 |
| 406.7000 | 6.876 | 0.153065 | 406.6080 | 12.180 | 0.184503 | 406.6860 | 18.658 | 0.142410 |
| 407.7290 | 6.722 | 0.141099 | 407.6320 | 11.997 | 0.163289 | 407.6970 | 18.527 | 0.125543 |
| 408.7560 | 6.583 | 0.128545 | 408.6550 | 11.837 | 0.149011 | 408.7160 | 18.409 | 0.107582 |
| 409.7770 | 6.470 | 0.098660 | 409.6730 | 11.701 | 0.119223 | 409.7350 | 18.307 | 0.092421 |
| 410.8040 | 6.373 | 0.091332 | 410.7020 | 11.591 | 0.106622 | 410.7530 | 18.219 | 0.090125 |
| 411.8200 | 6.290 | 0.070655 | 411.7280 | 11.491 | 0.095780 | 411.7690 | 18.138 | 0.074629 |
| 412.8500 | 6.219 | 0.064594 | 412.7410 | 11.399 | 0.079272 | 412.7760 | 18.068 | 0.067679 |
| 413.8670 | 6.158 | 0.058766 | 413.7590 | 11.331 | 0.056080 | 413.7890 | 18.003 | 0.053636 |
| 414.8790 | 6.105 | 0.039975 | 414.7780 | 11.274 | 0.051157 | 414.8020 | 17.956 | 0.041904 |
| 415.8880 | 6.064 | 0.038145 | 415.7960 | 11.224 | 0.049497 | 415.8100 | 17.915 | 0.041051 |
| 416.9160 | 6.028 | 0.029283 | 416.8110 | 11.177 | 0.039823 | 416.8240 | 17.872 | 0.037598 |
| 417.9330 | 5.997 | 0.026629 | 417.8270 | 11.143 | 0.033098 | 417.8420 | 17.839 | 0.028135 |
| 418.9430 | 5.971 | 0.025580 | 418.8380 | 11.115 | 0.023650 | 418.8590 | 17.811 | 0.026340 |
| 419.9700 | 5.951 | 0.016114 | 419.8540 | 11.090 | 0.033025 | 419.8660 | 17.787 | 0.021307 |
| 420.9750 | 5.935 | 0.022845 | 420.8750 | 11.059 | 0.021749 | 420.8800 | 17.767 | 0.023672 |
| 421.9900 | 5.918 | 0.010306 | 421.8840 | 11.044 | 0.013586 | 421.8810 | 17.743 | 0.018673 |
| 423.0010 | 5.907 | 0.011668 | 422.8940 | 11.033 | 0.009712 | 422.8960 | 17.726 | 0.014013 |
| 424.0090 | 5.897 | 0.006143 | 423.9090 | 11.018 | 0.024616 | 423.9080 | 17.716 | 0.005016 |
| 425.0180 | 5.888 | 0.009439 | 424.9130 | 11.003 | 0.012229 | 424.9140 | 17.704 | 0.014854 |
| 426.0280 | 5.884 | 0.004549 | 425.9240 | 10.991 | 0.010784 | 425.9220 | 17.686 | 0.014121 |
| 427.0410 | 5.875 | 0.008291 | 426.9350 | 10.981 | 0.010361 | 426.9440 | 17.673 | 0.010579 |
| 428.0550 | 5.868 | 0.005385 | 427.9460 | 10.972 | 0.006756 | 427.9410 | 17.666 | 0.005916 |
| 429.0620 | 5.864 | 0.001595 | 428.9570 | 10.962 | 0.012317 | 428.9550 | 17.660 | 0.005016 |
| 430.0750 | 5.862 | 0.002560 | 429.9580 | 10.954 | -0.009724 | 429.9600 | 17.655 | 0.005016 |
| 431.0890 | 5.859 | 0.007504 | 430.9750 | 10.956 | 0.006183 | 430.9670 | 17.650 | 0.005016 |
| 432.0880 | 5.855 | 0.001233 | 431.9860 | 10.947 | 0.005016 | 431.9850 | 17.645 | 0.001215 |
| 433.1070 | 5.852 | 0.001823 | 432.9860 | 10.939 | 0.009030 | 432.9850 | 17.643 | 0.000596 |

Table C-7: Continued

| 1wt% AO in Linear PMMA (10C/min) | | | 3wt% AO in Linear PMMA (10C/min) | | | 5wt% AO in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 434.1110 | 5.849 | 0.000265 | 434.0030 | 10.934 | -0.001517 | 433.9910 | 17.639 | -0.000414 |
| 435.1200 | 5.846 | 0.007932 | 435.0100 | 10.929 | 0.008497 | 435.0070 | 17.637 | 0.008770 |
| 436.1280 | 5.842 | -0.008112 | 436.0130 | 10.923 | -0.003250 | 436.0150 | 17.628 | -0.006178 |
| 437.1410 | 5.840 | 0.002997 | 437.0270 | 10.921 | 0.001388 | 437.0160 | 17.632 | -0.000447 |
| 438.1480 | 5.839 | 0.001143 | 438.0330 | 10.919 | 0.001409 | 438.0260 | 17.626 | 0.009488 |
| 439.1490 | 5.833 | 0.002076 | 439.0490 | 10.914 | 0.003799 | 439.0330 | 17.623 | 0.001500 |
| 440.1650 | 5.832 | 0.001219 | 440.0550 | 10.907 | 0.009249 | 440.0390 | 17.618 | 0.007699 |
| 441.1690 | 5.829 | 0.000550 | 441.0610 | 10.897 | -0.001116 | 441.0570 | 17.614 | 0.003139 |
| 442.1710 | 5.829 | 0.002326 | 442.0680 | 10.903 | -0.003450 | 442.0610 | 17.610 | 0.005016 |
| 443.1810 | 5.828 | 0.001823 | 443.0760 | 10.899 | 0.004418 | 443.0690 | 17.605 | 0.005016 |
| 444.1990 | 5.824 | 0.005066 | 444.0830 | 10.893 | 0.010298 | 444.0720 | 17.600 | 0.003173 |
| 445.1980 | 5.821 | 0.003373 | 445.0900 | 10.886 | -0.000329 | 445.0850 | 17.602 | 0.003206 |
| 446.2100 | 5.819 | -0.002115 | 446.1010 | 10.888 | 0.000207 | 446.0870 | 17.599 | -0.002849 |
| 447.2120 | 5.817 | 0.010527 | 447.0990 | 10.884 | 0.004429 | 447.0970 | 17.599 | 0.003195 |
| 448.2250 | 5.811 | -0.007555 | 448.1170 | 10.878 | 0.007364 | 448.1030 | 17.595 | 0.001438 |
| 449.2270 | 5.809 | 0.001710 | 449.1240 | 10.876 | -0.001677 | 449.1120 | 17.591 | 0.003162 |
| 450.2360 | 5.809 | -0.003464 | 450.1280 | 10.877 | -0.000298 | 450.1180 | 17.586 | 0.004100 |
| 451.2420 | 5.806 | 0.002918 | 451.1320 | 10.874 | 0.016966 | 451.1190 | 17.586 | -0.003081 |
| 452.2520 | 5.806 | 0.004347 | 452.1450 | 10.862 | 0.005016 | 452.1300 | 17.583 | 0.001330 |
| 453.2540 | 5.801 | 0.003333 | 453.1530 | 10.863 | -0.003554 | 453.1340 | 17.582 | 0.000622 |
| 454.2640 | 5.799 | 0.002322 | 454.1560 | 10.864 | 0.001917 | 454.1450 | 17.577 | 0.005016 |
| 455.2700 | 5.795 | 0.000858 | 455.1580 | 10.860 | 0.005016 | 455.1420 | 17.573 | -0.003824 |
| 456.2830 | 5.793 | 0.003654 | 456.1700 | 10.855 | 0.005016 | 456.1590 | 17.574 | 0.001330 |
| 457.2870 | 5.793 | 0.001414 | 457.1740 | 10.851 | -0.002439 | 457.1640 | 17.571 | -0.000382 |
| 458.2920 | 5.787 | 0.005451 | 458.1870 | 10.852 | 0.006864 | 458.1660 | 17.568 | 0.001396 |
| 459.3060 | 5.785 | 0.003645 | 459.1950 | 10.844 | -0.000004 | 459.1800 | 17.564 | 0.000464 |
| 460.3020 | 5.782 | -0.003197 | 460.2000 | 10.844 | 0.000236 | 460.1850 | 17.563 | 0.002333 |
| 461.3150 | 5.782 | 0.012467 | 461.2120 | 10.848 | -0.007079 | 461.1890 | 17.564 | 0.000408 |
| 462.3260 | 5.777 | -0.003015 | 462.2070 | 10.847 | 0.005583 | 462.1860 | 17.561 | -0.000052 |
| 463.3290 | 5.779 | 0.009844 | 463.2160 | 10.841 | 0.005624 | 463.2020 | 17.562 | 0.001307 |
| 464.3320 | 5.775 | 0.004190 | 464.2220 | 10.835 | 0.000704 | 464.2100 | 17.552 | 0.009680 |
| 465.3380 | 5.771 | 0.000265 | 465.2260 | 10.838 | -0.006269 | 465.2210 | 17.549 | -0.007111 |
| 466.3490 | 5.770 | 0.002961 | 466.2350 | 10.837 | 0.006808 | 466.2240 | 17.553 | -0.004089 |
| 467.3570 | 5.767 | 0.001698 | 467.2410 | 10.832 | 0.006225 | 467.2310 | 17.556 | -0.000547 |
| 468.3640 | 5.763 | 0.003591 | 468.2430 | 10.827 | -0.003299 | 468.2340 | 17.552 | 0.008770 |
| 469.3670 | 5.761 | -0.001109 | 469.2450 | 10.830 | 0.001494 | 469.2420 | 17.549 | -0.016835 |
| 470.3700 | 5.759 | 0.000182 | 470.2540 | 10.830 | -0.001718 | 470.2410 | 17.556 | -0.001282 |
| 471.3800 | 5.760 | 0.003981 | 471.2550 | 10.825 | 0.009712 | 471.2500 | 17.554 | 0.005016 |
| 472.3840 | 5.755 | -0.000746 | 472.2700 | 10.822 | -0.006934 | 472.2560 | 17.549 | 0.005016 |
| 473.3900 | 5.757 | 0.005924 | 473.2720 | 10.825 | 0.003828 | 473.2640 | 17.550 | -0.011571 |
| 474.3990 | 5.751 | 0.002148 | 474.2730 | 10.822 | 0.003191 | 474.2710 | 17.553 | 0.001438 |
| 475.4000 | 5.751 | 0.001121 | 475.2800 | 10.810 | 0.012186 | 475.2780 | 17.549 | 0.005910 |
| 476.4110 | 5.748 | 0.001629 | 476.2900 | 10.808 | -0.005264 | 476.2850 | 17.544 | 0.005016 |
| 477.4080 | 5.744 | 0.002878 | 477.2940 | 10.811 | -0.006723 | 477.2890 | 17.545 | -0.011471 |
| 478.4180 | 5.741 | 0.002434 | 478.3020 | 10.815 | 0.013925 | 478.2910 | 17.547 | 0.002424 |
| 479.4240 | 5.741 | -0.000548 | 479.3100 | 10.805 | 0.002011 | 479.2980 | 17.545 | -0.009754 |
| 480.4310 | 5.740 | 0.004124 | 480.3110 | 10.808 | 0.005016 | 480.3120 | 17.551 | 0.004116 |
| 481.4360 | 5.737 | 0.004330 | 481.3160 | 10.805 | -0.001986 | 481.3190 | 17.546 | -0.002401 |
| 482.4420 | 5.732 | 0.000209 | 482.3200 | 10.804 | 0.016103 | 482.3250 | 17.544 | 0.004106 |
| 483.4510 | 5.735 | -0.001265 | 483.3280 | 10.801 | -0.003201 | 483.3250 | 17.542 | -0.007580 |
| 484.4570 | 5.733 | 0.003781 | 484.3410 | 10.804 | 0.005617 | 484.3370 | 17.543 | 0.001330 |
| 485.4540 | 5.730 | 0.003138 | 485.3440 | 10.803 | -0.001759 | 485.3320 | 17.541 | 0.001500 |
| 486.4730 | 5.727 | -0.000777 | 486.3470 | 10.802 | 0.006819 | 486.3410 | 17.539 | 0.001480 |
| 487.4770 | 5.728 | 0.002910 | 487.3600 | 10.798 | 0.007435 | 487.3480 | 17.539 | -0.004089 |
| 488.4750 | 5.720 | 0.002952 | 488.3640 | 10.794 | -0.007227 | 488.3540 | 17.542 | -0.001357 |
| 489.4810 | 5.723 | -0.002531 | 489.3660 | 10.797 | 0.000207 | 489.3660 | 17.540 | -0.004199 |
| 490.4900 | 5.722 | 0.003346 | 490.3750 | 10.794 | 0.005016 | 490.3640 | 17.541 | 0.007668 |
| 491.4910 | 5.718 | 0.004919 | 491.3750 | 10.790 | 0.000907 | 491.3700 | 17.536 | -0.000414 |
| 492.5020 | 5.715 | -0.001484 | 492.3810 | 10.792 | -0.008726 | 492.3770 | 17.539 | 0.002364 |
| 493.5030 | 5.714 | 0.001427 | 493.3900 | 10.794 | 0.009883 | 493.3820 | 17.541 | -0.004999 |
| 494.5110 | 5.712 | 0.004874 | 494.3960 | 10.784 | 0.003842 | 494.3870 | 17.542 | 0.006754 |
| 495.5130 | 5.708 | 0.001609 | 495.4010 | 10.786 | -0.001636 | 495.3970 | 17.537 | 0.003184 |
| 496.5220 | 5.707 | 0.004828 | 496.4140 | 10.788 | 0.001494 | 496.4040 | 17.538 | 0.003173 |
| 497.5320 | 5.706 | 0.001463 | 497.4120 | 10.781 | 0.009174 | 497.4140 | 17.539 | -0.002586 |
| 498.5380 | 5.702 | 0.005545 | 498.4230 | 10.778 | -0.001031 | 498.4240 | 17.540 | 0.005960 |
| 499.5390 | 5.705 | -0.006482 | 499.4220 | 10.782 | 0.001992 | 499.4150 | 17.535 | 0.005016 |

Table C-7: Continued

| 1wt% AO in Linear PMMA (10C/min) | | | 3wt% AO in Linear PMMA (10C/min) | | | 5wt% AO in Linear PMMA (10C/min) | | |
|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) | Temperature (°C) | mass (%) | mass loss rate (%/°C) |
| 500.5460 | 5.707 | 0.002557 | 500.4330 | 10.779 | 0.001992 | 500.4310 | 17.534 | -0.003034 |
| 501.5590 | 5.710 | -0.002316 | 501.4420 | 10.777 | 0.002654 | 501.4310 | 17.536 | 0.000596 |
| 502.5560 | 5.711 | -0.000970 | 502.4480 | 10.772 | 0.005016 | 502.4400 | 17.535 | 0.005016 |
| 503.5620 | 5.713 | 0.005255 | 503.4510 | 10.770 | -0.005021 | 503.4420 | 17.536 | -0.004328 |
| 504.5600 | 5.708 | 0.002906 | 504.4640 | 10.773 | -0.001106 | 504.4560 | 17.539 | 0.010579 |
| 505.5750 | 5.709 | -0.003438 | 505.4640 | 10.769 | 0.008558 | 505.4620 | 17.532 | 0.005016 |